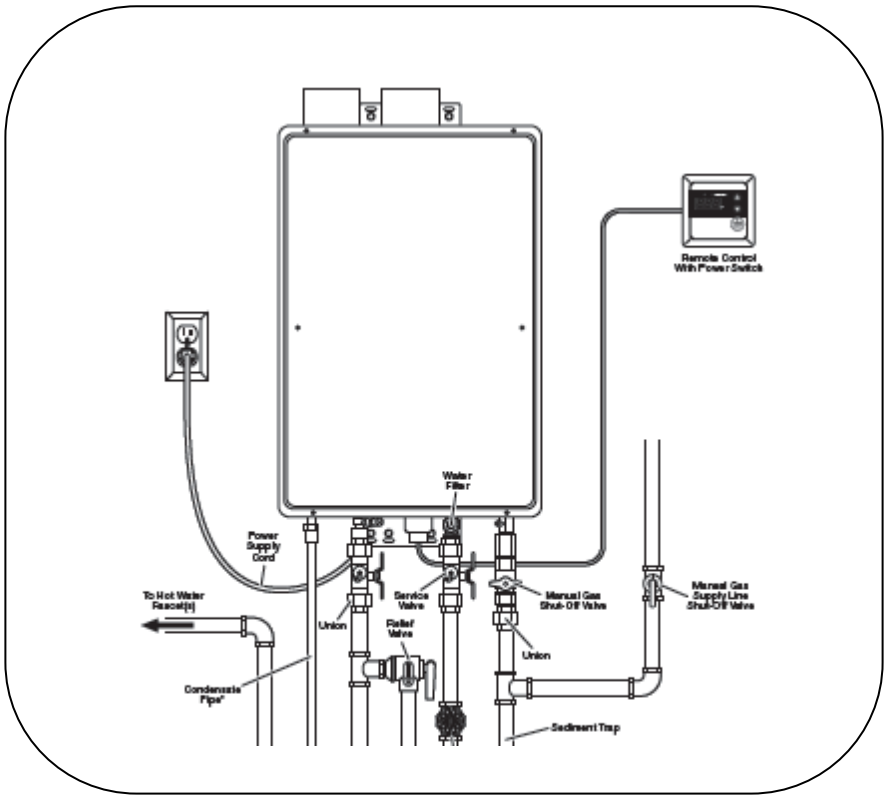
http://waterheatertimer.org/Troubleshoot-Rheem-Tankless-water-heater.html

RHEEM MANUFACTURING COMPANY

Tankless Gas Troubleshooting Manual SVC 820

Mid & High Efficiency Platform



The purpose of this manual is twofold: it serves as a training tool as well as a troubleshooting manual for qualified installers and service technicians. Technical Support (800)-432-8373 www.rheem.com

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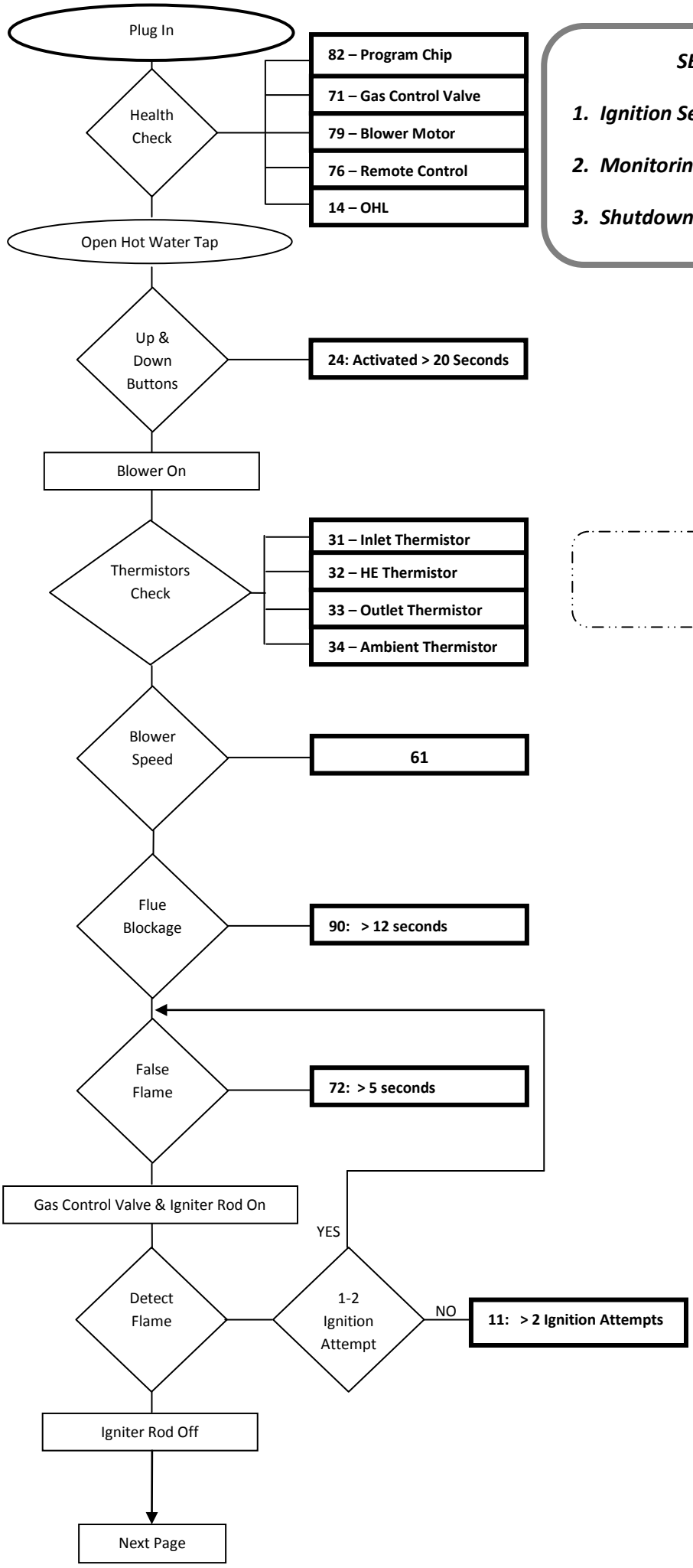
Specifications common to all models

Model	See specification sheets for current models and specs
Purpose	Domestic Hot Water (DHW) supply for showers, cleaning, and laundry
Rated Gas Input Btu/Hr.)	See specification sheets for current models and specs
Dimensions	See specification sheets for current models and specs
Installation	*Indoor Wall Mounting* : Can be vented horizontally or vertically *Outdoor Wall Mounting* : Venting not required *Mid Efficiency* : ONLY uses Stainless steel (Category III; 316L Certified) concentric venting for indoor installation *High Efficiency*: Uses PVC; CPVC; ABS; or Stainless Steel (Category III; 316L Certified) venting for indoor installation
Working Water Pressure	14 PSI minimum; 150 PSI maximum
Minimum Water Flow	0.4 GPM to activate burner; can be reduced to .26 GPM once burner is activated
Maximum Water Flow	Based on 35 degree rise; See specification sheets for current models and specs
Gas Connection	3/4” NPT Male
Water Connection	3/4" NPT Male
Vent Size	Mid Efficiency: 3”/5” Concentric Vent High Efficiency: 2” or 3” Two Pipe Venting (optional concentric vent termination)
Max Vent Length	See Use & Care Manual for each product type
Inlet Gas Pressure	*Natural Gas*: Minimum 4.0” w.c. Maximum 10.5” w.c. *L.P. Gas* : Minimum 8.0” w.c. Maximum 14.0” w.c.
Hot Water Supply Temperatures	*Factory Setting*: 85F – 140F (Up to 140 with Override Adjustment) *Commercial Setting*: Up to 185F via program chip
Electrical	*Rating*: 120 VAC/60Hz, 3 Amps *Wire* : Indoor Models - 3 Prong (Edison) Power Supply Cord Outdoor Models – require field wiring *Fuse* : 3A Fuse x 2 (line voltage)
Safety Devices	Flame Rods Overheat Film Wrap for Heat Exchanger Heat Exchanger Thermistor (Boiling Point Safety) Electronic Burner and Combustion Monitoring and Control
Freeze Protection	Minus 30F (Without Wind-Chill Factor) with power applied
Remote Control	Standard: Main Remote Control UMC-117 (included) Optional: Bath Remote Control USC1-117 – 120 F Max Limit Optional: Second Bath Remote USC2-117 – 120 F Max Limit Only one of each type remote above can be installed on a single unit Only one of each type remote above can be installed on multiple manifold units

Sequence of Operations

ACTION		***EXPLANATION***
Hot water faucet is open creating a demand		Hot water draw initiates water flow thru the water heater
Water flows thru the Water Flow Sensor		Minimum flow rate of .4 GPM to activate @ 35^{o} △T
Control Board senses the flow rate has reached a minimum demand of .4 GPM@ 35^{o} △T		Control Board is the 'brains' of the machine and controls all input and actions during sequence of operations
Blower Motor conducts a pre-purge		Pre purge is designed to verify we have a clear and clean vent and supply oxygen to burner for proper ignition
The Proportional Gas Flow Regulator allows the gas to flow to the main burner		Proportional Gas Flow Regulator initially opens to 75% of BTU input
Simultaneously, the Igniter Rod sparks and ignites the main burner		The Igniter Rod ignites the fuel in the main burner area. All burners will fire initially
After ignition, the Flame Rods sense and monitor the flame and ensure proper combustion		The purpose of the flame rods is to verify flame and proper combustion. In the event of flame failure or improper combustion, the unit will go into an error code
The "In Use Indicator" on the remote control turns "ON" (Red) and the "Priority Indicator" is Green (multiple remote controls)		Main burner is now lit. The PCB goes thru a series of calculations (input sensing) to balance out the cold-water temperature, the thermostat setting, the hot outlet temperature, and the BTU required to heat the water.
The Proportional Gas Flow Regulator continuously adjusts the gas volume in order to maintain the outlet temperature. The water flow sensor also adjusts the proper amount of cold water mix flow to supply a stable hot water temperature at all times. A signal is also sent to the Blower Motor in order to constantly maintain the correct proportion between gas and air volumes		The PCB is constantly monitoring all of these inputs and actions to ensure the outlet water temperature is within 1-5 degrees of thermostat setting. It also monitors the BTU required to heat the cold water to the thermostat setting and adjusts the gas valve accordingly
(Indoor Models Only) When the air intake is blocked, or oxygen is not sufficient, the output of the Flame Sensor changes		The PCB senses this change and controls the Fan and Gas Valve in order to prevent imperfect combustion. If the PCB cannot correct such condition, the unit will go into an error code
When the hot water tap is closed, the flow rate signal from the water flow sensor stops		Gas valve is closed. Main burner shuts off
The Fan continues to run for a few minutes		Purpose is to cool the heat exchanger, exhaust all combustions gases, and to maintain the burner chamber charged with air for immediate ignition if there is another hot water demand

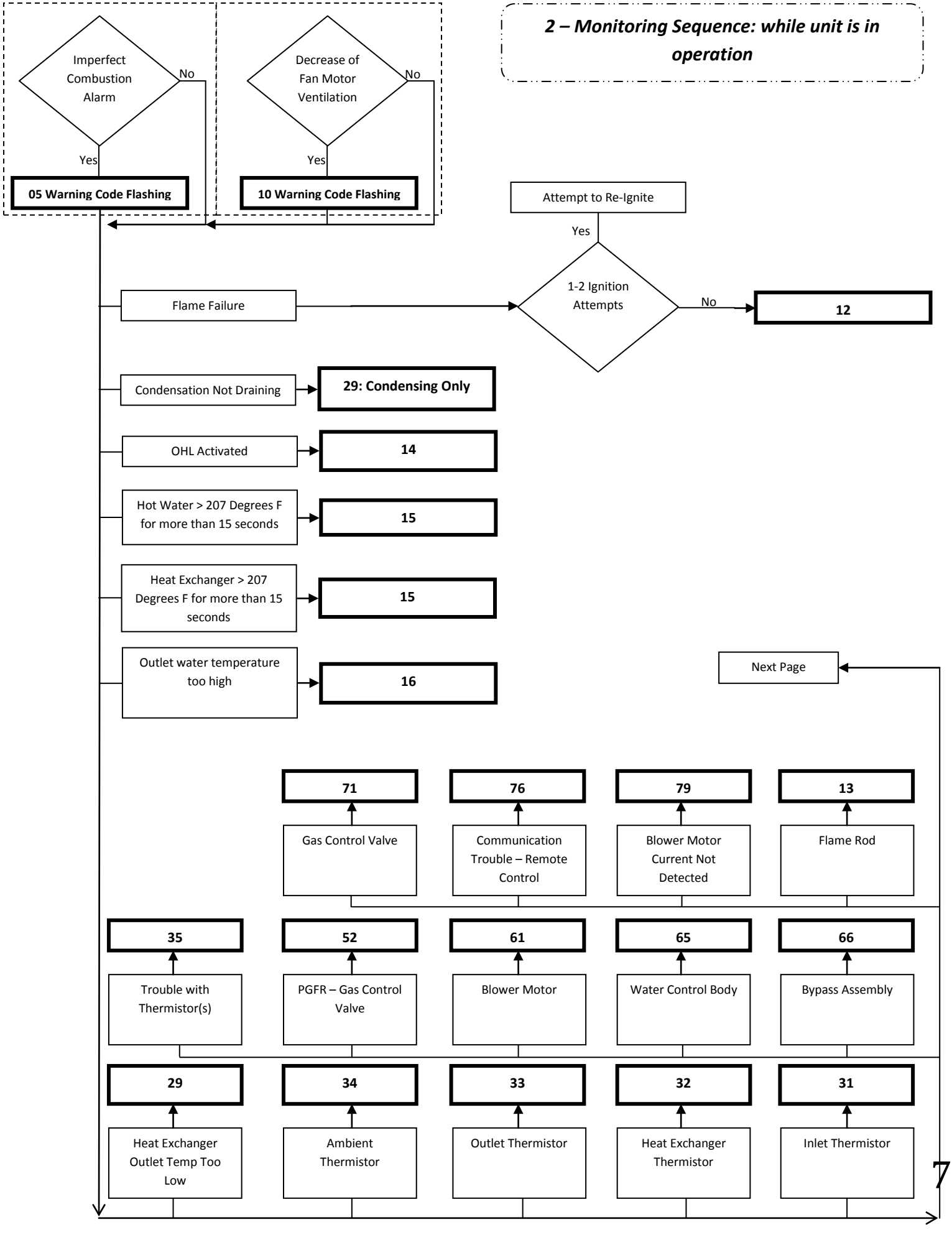


SEQUENCE OF OPERATIONS:

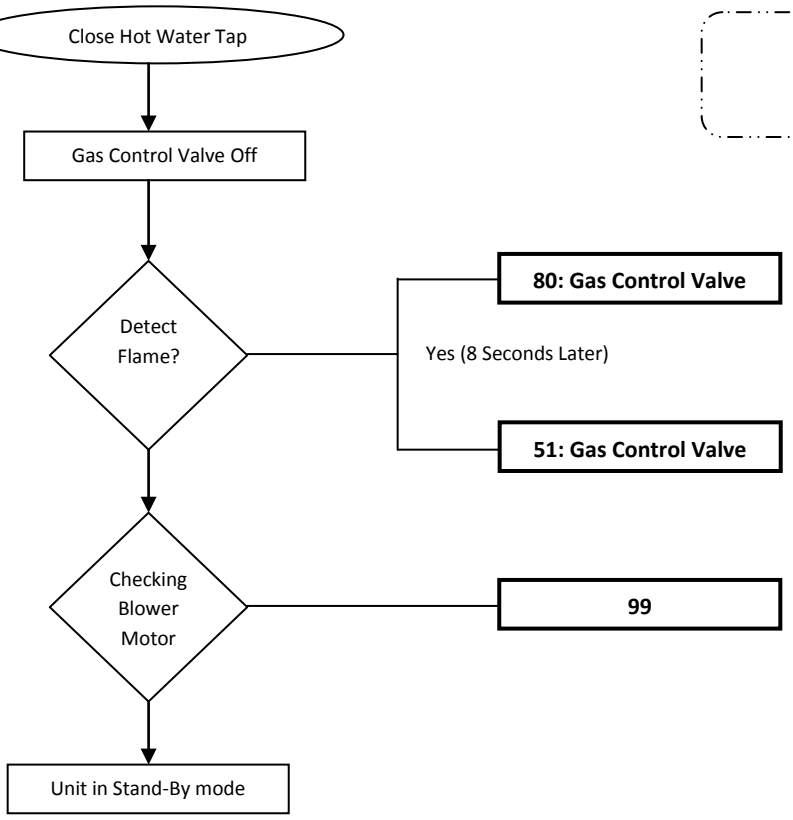
1. ***Ignition Sequence***
2. ***Monitoring Sequence***
3. ***Shutdown Sequence***

1 – Ignition Sequence

2 – Monitoring Sequence: while unit is in operation



3 – Shutdown Sequence



Error Code

Code	Fault	Remedy
No Code	*Flow Rate/Maintenance:* Nothing Happens When Water Is Flowing Through Unit. *(Control Board Displays Water Temp)*	1. Increase water flow rate or set higher temperature 2. New Installations: Ensure hot and cold water lines are not crossed 3. Check for plumbing crossover in the home 4. Clean water inlet filter 5. Check water flow sensor (may be jammed)
P1	*Maintenance Warning:* Water Flow Too Low *(Unit Will Still Be Operable; Minimum Flow 0.4 GPM To Activate @ 35^{o} △T)*	1. Check hot water tap flow (clean aerator if necessary) 2. Clean water inlet filter 3. Increase flow rate or set higher temperature If maintenance requirements are met: 1. Check water flow sensor
1L	*Maintenance:* Water Heater Has Buildup Of Lime/Scale Deposits	1. Flush Heat Exchanger 2. High Altitude Installations: ensure proper altitude settings have been made
03	MIC 185, MIC 6, & EZ Link	1. Check communications cable connection 2. Check # 4 dip switch setting is in the 'ON' position *(Dip Set # 1 (Top), Dip switch # 4 on the water heaters only)*
05	*Maintenance Warning:* Air Intake Or Vent Exhaust May Be Blocked (Unit Will Still Be Operable)	1. Remove any vent blockage 2. Make sure venting meets all installation requirements *If maintenance requirements are met:* 1. Check fan motor
	Installation Warning: The vent Pipes On The Vent Termination May Not Be Connected (Unit Will Still Be Operable)	Make sure all venting is properly sealed and meets all venting requirements (diameter; vent lengths; venting material; venting obstructions; and all other installation requirements as described in installation manual) *If installation requirements are met:* 1. Check Blower Motor

10	*Maintenance:* Decrease Of Ventilation Amount (Blower Motor)	Clean any blockage in venting, Blower Motor, air intake *If maintenance requirements are met:* 1. Check Blower Motor
11	*Installation/Gas supply:* Ignition Failure	1. Ensure you have gas to the appliance and valves are turned 'ON' 2. Ensure gas type, gas pressure, and gas volume are correct 3. Bleed all air from gas lines 4. Ensure gas line, meter, and regulator are sized properly 5. Ensure appliance is properly grounded *If installation/gas supply requirements are met:* 1. Check Gas Control valve for open or short circuits 2. Ensure Igniter Rod is operational 3. Check igniter/Flame Rod(s) and Igniter/Flame Rod(s) wiring harness for damage 4. Check Control Board 5. Check Flame Rod Status
12	*Gas supply/Installation/ Maintenance:* Flame Failure (Had Main Burner, Then Lost It)	1. Ensure gas type and pressure is correct 2. Bleed all air from gas lines 3. Ensure Flame Rod wire(s) is connected 4. Check Flame Rod(s) for carbon build-up 5. Ensure gas line, meter, and regulator are sized properly 6. Ensure appliance is properly grounded 7. Check power supply for proper voltage and voltage drops 8. Disconnect and re-connect all wiring harnesses on Gas Control Valve and Control Board *If gas supply/installation/maintenance requirements are met:* 1. Check gas valves for open or short circuits 2. Check flame rod(s) and flame rod(s) wiring harness for damage 3. Check PCB 4. Check flame rod(s) status

13	*Indoor ONLY* *Venting:* Flame Rod FL-2: Reads Poor Or Improper Combustion	Ensure intake and exhaust venting meet all installation requirements (diameter; vent lengths; venting material; venting obstructions; and all other requirements as described in the Use & Care manual **{Make sure exhaust is not recirculating into fresh air intake}**) *If venting requirements are met:* 1. Remove any blockage from venting or from in front of vent termination 2. Verify altitude settings 3. Check Flame Rod FL-2 4. Check Blower Motor
14	***Condensing only:*** *Maintenance:* Flue Temperature Too High	***Condensing Only:*** 1. Clean blockage in heat exchanger *2.* Remove any blockage from Blower Motor and exhaust vent
	Mid Efficiency & Condensing: Over Heat Limiter (OHL) Fault	***Mid Efficiency & Condensing:*** *If 'Condensing' maintenance requirements are met:* 1. Verify "U" connector is connected to Control Board 2. Verify wiring harness is connected to OHL 3. Check heat exchanger for cracks and/or separations 4. Inspect Overheat Wrap (Overheat wrap failure: Replace unit) 5. Check thermal overload sensor (condensing models only)
15	*Maintenance:* Boiling Safety Device (Heat Exchanger temperature reached 207 F degrees for more than 15 seconds)	1. Flush Heat Exchanger (lime/scale buildup) 2. Check for closed water heater inlet valve or restrictions in cold water inlet pipe (must be fully open) 3. On commercial water heater, lower set point temperature below 180^0F at high altitudes *If maintenance requirements are met:* 1. Check Heat Exchanger Thermistor
16	*Maintenance:* Outlet Water Temperature Is Above Remote Thermostat Setting	1. Check for clogged Heat Exchanger 2. Check for restrictions in airflow around unit and vent terminal *If maintenance requirements are met:* 1. Check Outlet Thermistor 2. Check Heat Exchanger Thermistor 3. Check gas valve

24	Malfunction Of Operational Switch	1. Turn off water. Disconnect Remote Control and retry 2. Verify unit is electrically grounded 3. Press MIN and MAX button on Control Board to reset
29	***Condensing Only:*** *Maintenance:* Neutralizer Is clogged	***Condensing Only:*** 1. Ensure shipping cap for drain line is removed and drain line is not blocked 2. Clear all neutralizer drainage ports inside of unit 3. Clear neutralizer drainage line outside of unit 4. Clean air inlet screen 5. Clean heat exchanger fins *If maintenance requirements are met:* 1. Check neutralizer water level electrode
	Mid Efficiency & Condensing: *Maintenance:* Heat Exchanger Temperature Is Too Low	***Mid Efficiency & Condensing:*** 1. Clean air inlet screen 2. Clean heat exchanger fins
31	Inlet Thermistor	1. Check Thermistor wiring for damage 2. Check and clean scale from Thermistor 3. Ohm Thermistor
32	Heat Exchanger Thermistor	1. Check Thermistor wiring for damage 2. Check and clean scale from Thermistor 3. Ohm Thermistor
33	Outlet Thermistor	1. Check Thermistor wiring for damage 2. Check and clean scale from Thermistor 3. Ohm Thermistor

34	Ambient Thermistor	1. Check Thermistor wiring for damage 2. Check and clean Ambient Thermistor 3. Ohm Thermistor *If wiring and component readings are normal:* 1. Check for restrictions in airflow around unit and vent terminal 2. Ensure fan blade is tight on motor shaft and spins freely
35	Improper Thermistor Connection	1. Check that all Thermistors are secured to proper connections on Control Board 2. Check that all quick connectors between Control Board and Thermistors
51	Gas Control Valve	1. Check Gas Control Valve wiring harness for loose or damaged terminals 2. Ohm Gas Control Valve
52	PGFR Valve (Modulating Valve)	1. Check PGFR Valve wiring harness for loose or damaged connections 2. Ohm PGFR Valve
61	*Installation/Maintenance:* Blower Motor	1. Ensure Blower Motor will turn freely. Motor will operate with a small amount of restriction 2. Check wiring harness to Motor for damaged and/or loose connections 3. Check venting length not to exceed max lengths and bends
65	Water Control Valve	1. Check Water Control Valve wiring harness for loose or damaged terminals 2. Check for proper voltage to Water Control Valve
66	Water Bypass Valve	1. Check Water Bypass Valve wiring harness for loose or damaged terminals 2. Check for proper voltage to water by-pass solenoid
71	Gas Control Valve	1. Check Gas Control Valve wiring harness for loose or damaged terminals 2. Ohm Gas Control Valve
72	Flame Rod (Detected False Flame)	1. Ensure Flame Rod(s) is touching flame when unit fires 2. Check inside burner chamber for any foreign material blocking flame at Flame Rod(s) 3. Check all wiring to Flame Rod for damage 4. Check Flame Rod for proper voltage 5. Remove Flame Rod and check, clean with steel wool (Do not use sandpaper)

76	Communication Fault With Remote Control	1. Check Remote Control wiring for loose or damaged connections 2. Bypass Remote Control: connect Remote Control directly to remote connection at bottom of the heater. Replace cable if found to be faulty 3. Remove water heater power cord from 3 prong outlet. Disconnect the Remote Control. Plug heater back into supply and test heater without Remote Control connected
79	Blower Motor Current Fault	1. Ensure Blower Motor will turn freely. Motor will operate with a small amount of restriction 2. Check Fan Motor for proper voltage and for water (condensation) damage
80 & 81	Gas Control Valve	1. Ohm Gas Control Valve 2. Check voltage of all Flame Rods
82	*Installation:* Control Board Is Not Programmed.	Verify Program Chip is installed
90	*Maintenance/Installation:* Blocked Flue/Air Intake	Clean any blockage in Heat Exchanger, Blower Motor, inlet flue and exhaust flue
92	***Condensing Only:*** *Maintenance Warning:* Neutralizer Needs To Be Replaced (Unit Will Still Be Operable)	Replace Neutralizer
93	***Condensing Only:*** *Maintenance:* Neutralizer Must Be Replaced (Unit Will NOT Operate)	Replace Neutralizer
99	*Maintenance/Installation:* Blower Motor Cannot Vent	1. Clear vent blockages 2. Check for blocked Heat Exchanger

COMPONENTS

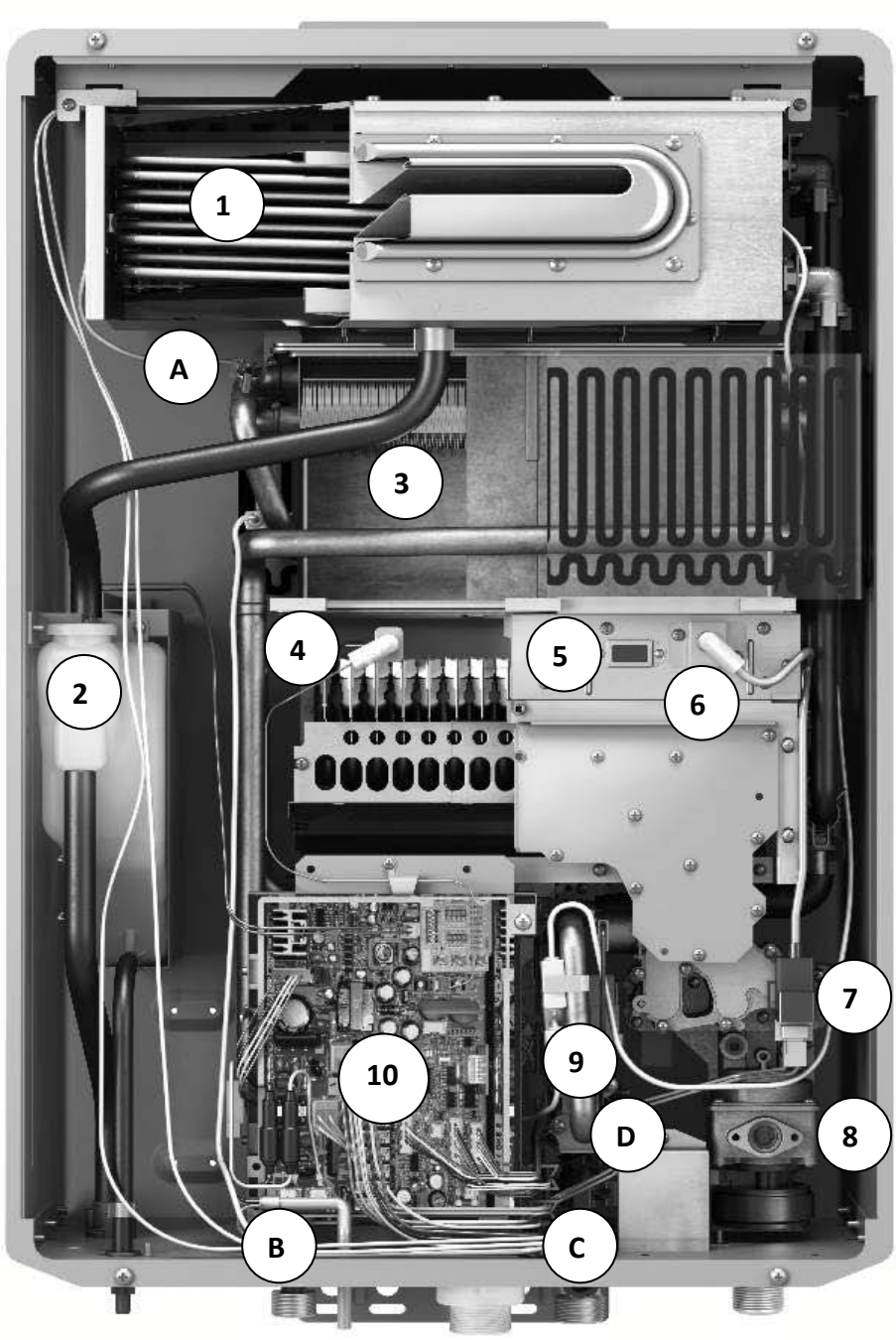
1. Condensing ONLY: Secondary Stainless Steel Heat Exchanger
2. Condensing ONLY: Neutralizer
3. Primary Heat Exchanger
4. Flame Rod(s)
5. Sight Glass
6. Igniter Rod
7. Igniter Coil
8. Gas Control Valve
9. Water Control & Bypass Valve
10. Control Board
11. Blower Motor (Behind Control Board)

A. Heat Exchanger Thermistor

B. Outlet Thermistor

C. Inlet Thermistor

D. Ambient Thermistor



Maintenance Mode Panel Display

The Rheem Tankless has a Maintenance Mode chart on the Remote Control. To access the Maintenance Mode, turn the unit OFF at Remote Control and make sure water flow is OFF. Then hold down the UP and DOWN arrow keys at the same time for 5 seconds. You will hear an audible beep and see the display go to 1E. By pressing the UP and DOWN arrow keys on the remote thermostat, you can access a variety of information about the water heater. To activate the unit while displaying the maintenance panel: push the power button once, open a hot water fixture, and the green LED will illuminate. This will allow you to access a variety of real time information while the unit is in operation.

Shortcut: Lift dip switch #1 to the up position to go immediately into maintenance mode. This can be done while the water heater is in operation.

While in Maintenance Mode you want to push the up ▲ arrow key to select the table you wish to view. The table is designated by a letter and is always displayed as the second digit. Then push the down ▼ arrow key to display the number item in the table you selected. You can select as many as 8 readings for each table.

To perform diagnostics in this service manual, press the up ▲ arrow until you get to table **1Y**.

Now using your down ▼ arrow you can change the number in front of **Y**. As you move through the diagnostic readings, the selected table will flash first and then the diagnostic reading. You will see the following as you navigate the **Y** table:

0Y = Flame Rod Status

1Y = Water Flow in gallons per minute

2Y = Ambient air temperature

3Y = Water inlet temperature

4Y = Heat exchanger temperature

5Y = Hot water outlet temperature

6Y = Fan speed (x 100 rpm)

7Y = Power for modulating gas valve

8Y = Null (no reading)

9Y = Null (no reading)

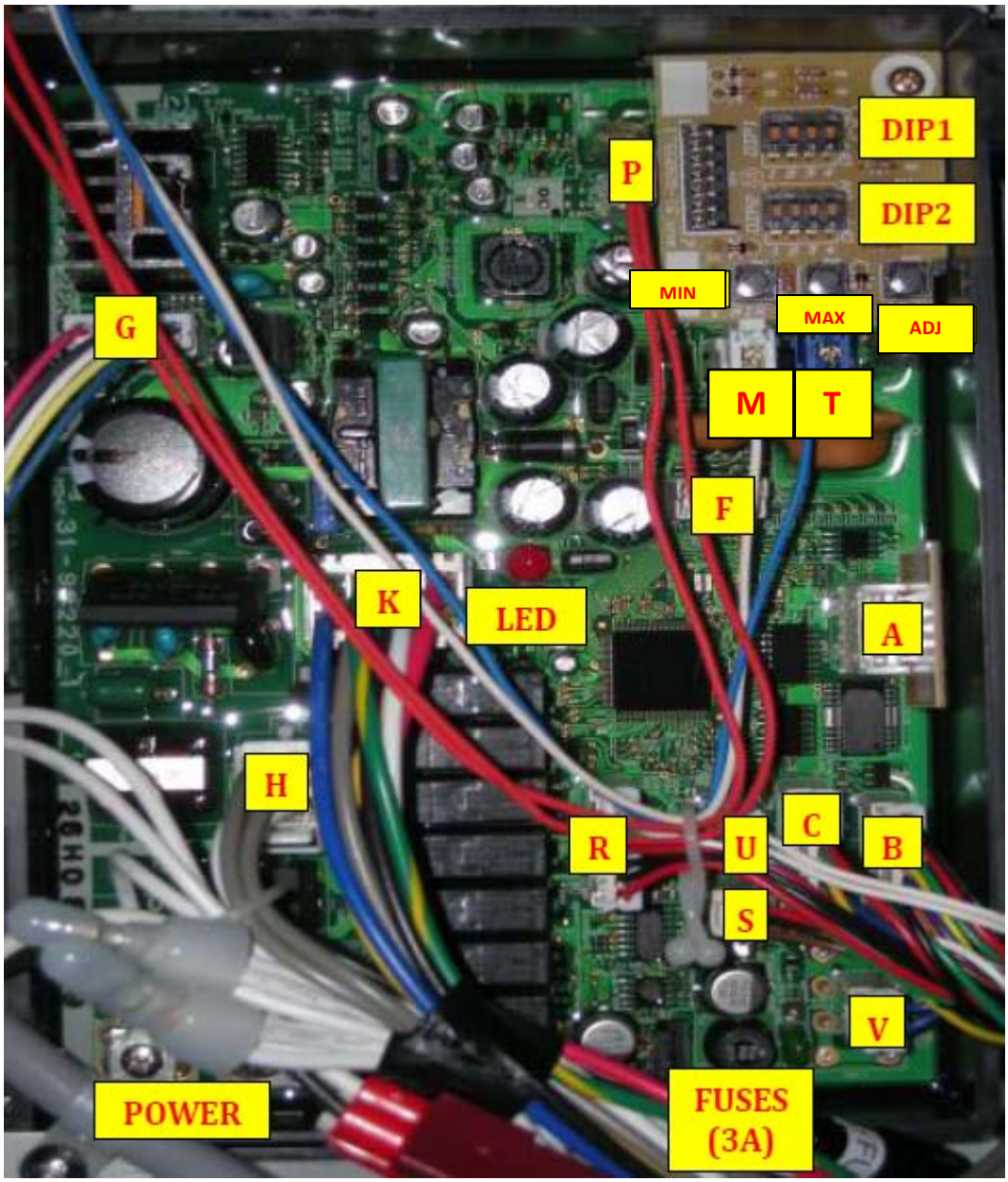
FULL MAINTENANCE DISPLAY CHART AVAILABLE ON NEXT PAGE

MAINTENANCE INFORMATION TABLE

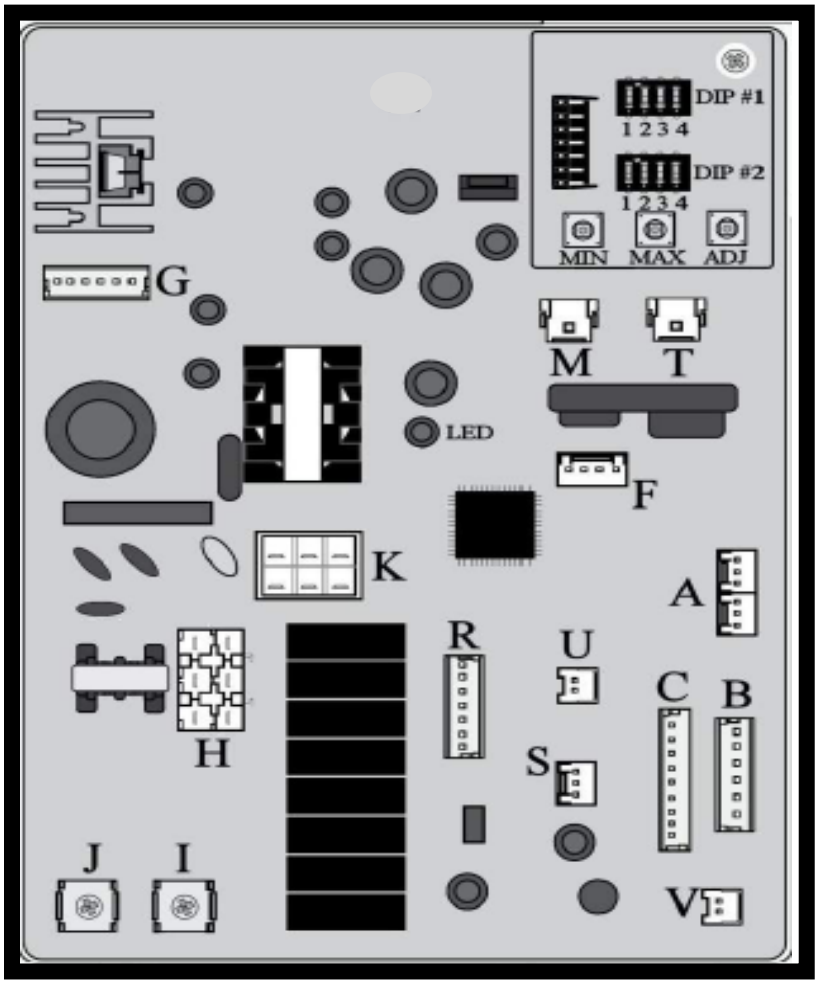
	First Digit – Use DOWN arrow key on Remote Control										
Second Digit – Use UP arrow key on Remote Control		0*	1*	2*	3*	4*	5*	6*	7*	8*	9*
	E	***Null***	***Fault Codes of the most recent 8 faults***								***Null***
	*F	Null	Sequence Number of the most recent 8 faults								Null
	*C		Total combustion times until recent error fault (** x 10000times)								Null
	*D		Total combustion times until recent error fault (** x 100 times)								Null
	*H		Total combustion period until recent error fault (** x 1000 hours)								Null
	*J		Total combustion period until recent error fault (** x 10 hours)								Null
	Y	**Flame Rod Status**	**GPM Flow Rate (*.* GPM)**	**Ambient Air Temperature**	**Cold Water Inlet Temperature**	**Heat Exchanger Temperature**	**Hot Water Outlet Temperature**	**Fan Speed x 100 RPM**	**Power for P.G.F.R. valve**	**Null**	**Null**
	*A	Null	Control Line	Fan Detective Value	Fan Motor Current	Null	Null	Null	Null	Null	Sequence Number

CONTROL BOARD – Color Picture

- *Each letter indicates the connector identifier*



CONTROL BOARD



DIP #1 – *Adjust max temperature; EZ Link cable*

DIP #2 – *Adjust for altitude differential*

MIN & MAX – *Adjust water temperature setting; gas pressure; etc.*

ADJ – *Adjust gas pressure etc.*

M – *Flame Rod for all models (detects flame)*

T – *Flame Rod for indoor models only (monitors combustion efficiency)*

F – *Communication port (manifold installations)*

A – *Fuel type and temperature Program Chip*

U – *Over Heat Limiter (OHL)*

R – *Thermistors (Ambient, Inlet, Outlet, Heat Exchanger) & Modulating Gas Valve (PFGR)*

S – *Water Flow Sensor*

C – *Water Control Valve*

B – *Water Bypass Valve*

V – *Remote Control (Main Bath)*

G – *Blower Motor*

K – *Gas Control Valve*

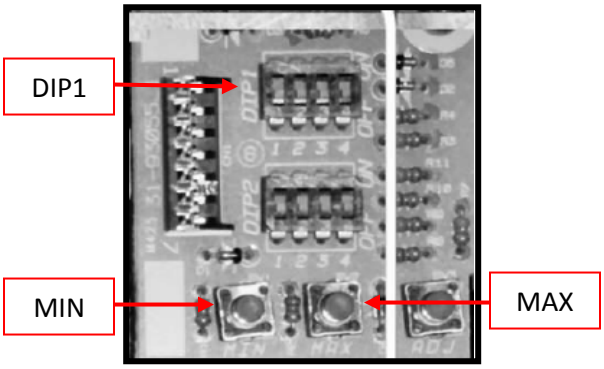
H – *Igniter Rod*

NOTES:

RESET PROCEDURE:

ONLY for 'Hard Lockouts' - Error Codes: 13; 92; 93; 99

1. Turn Remote Control OFF; leave unit plugged in. Remove Front Cover. Locate the Dip Switches (Upper Right on the Control Board).
2. Make sure all the Dip Switches are OFF (down position).
3. Locate Dip1 – Switch #2 and turn it ON (up position) then immediately turn it off.
4. Within 5 seconds, press and hold the MIN and MAX buttons for at least 2 seconds.
5. The Remote Control will flash "UL" then it will go solid. This indicates the heater has been reset.
6. Release the buttons.
7. Turn Remote Control ON. You may operate unit.



CLEARING FAULT HISTORY PROCEDURE:

1. Turn Remote Control OFF; leave unit plugged in. Remove Front Cover. Locate the Dip Switches (Upper Right on the Control Board).
2. Make sure all the Dip Switches are OFF (down position).
3. Locate Dip1 – Switch #1 and turn it ON (up position) then immediately turn it off.
4. Within 5 seconds, press and hold the MIN or MAX button for at least 2 seconds.
5. The Remote Control will flash "CL" then it will go solid. This indicates the fault history has been cleared.
6. Release the buttons.
7. You can verify clearing history by entering Maintenance Mode and check the code at location 1E. Should read NULL (- - two dashes).
8. Turn Remote Control ON. You may operate unit.

No Error Code & No Hot Water

(Remote Control Displays Hot Water Temperature Setting)

Explanation: No hot water is delivered when water is flowing through unit and Remote Control displays the hot water temperature setting.

Possible Causes:

- *Water Flow (Minimum flow of 0.4 GPM to activate)*
- *DIP 1 Setting On Main Control Board (PCB)*
- *Water flow sensor*

Water Flow:

1. Turn OFF water supply to unit. Turn Remote Control OFF; unplug power cord at wall outlet. Wait 10 seconds; plug power cord back into outlet; wait 20 seconds; turn the Remote Control ON. Turn water supply ON; check the nearest hot water fixture for hot water. If you have hot water, then the unit needed to be reset.

2. Water flow might be too low. Open multiple hot water fixtures. If unit fires then there is not enough water flow to engage the unit at a particular fixture. Check your fixture aerator screen(s) for debris. Clean if necessary.

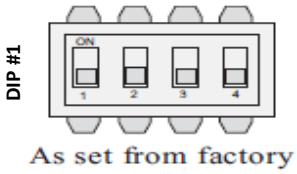
3. Your water flow may be restricted by debris in Water Filter. Remove the water filter and inspect. Clean if necessary.

4. Your water lines might be crossed. Make sure your hot and cold water supply lines are connected to the appropriate hot and cold water assembly connections on the unit.

Dip 1 Setting:

All Dip 1 switches must be in the 'OFF' position.

Manifold Units ONLY: Go to Error Code 03 to verify proper DIP 1 setting

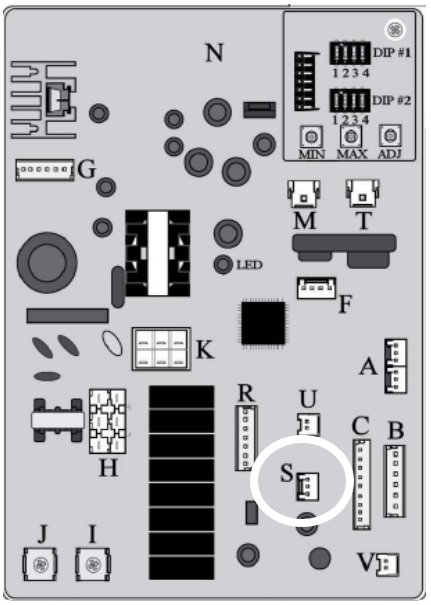


Water Flow Sensor:

FINAL CHECK: The water flow sensor in the water volume control valve

Check connector S between the Red and Black. With the unit ON and no water flow, you should be 11-17 DC volts. If not, replace the PCB. IF you have voltage, then.....

With the water flowing, measure 2-5 DC volts between the Brown and Black wire. (This is measuring water flow thru the control). IF you have a reading and no main burner, replace the PCB. If you do not have a reading, replace the water flow sensor.



P1 - Warning Code

Explanation: No hot water is delivered when water is flowing through unit and Remote Control displays **P1**. When water flow does not reach a minimum 0.4 GPM rate @ 35°△T, for five seconds, **P1** warning code is displayed.

Possible Causes:

- *Not Enough Water Flow*

Water Flow:

Turn the water supply to the unit off. Turn the remote thermostat off, wait 10 seconds and turn the remote thermostat on. Turn the water supply to the unit on and check the nearest hot water fixture for hot water. If you have hot water, then the unit needed to be reset.

Your water lines might be crossed. Make sure your hot and cold water supply lines are connected to the appropriate hot and cold water connections on the unit.

Water flow might be too low. Open multiple hot water fixtures. If unit fires then there is not enough water flow to engage the unit at a particular fixture. Check your fixture aerator screen(s) for debris. Clean if necessary.

Your water flow may be restricted by a dirty In-Line Water Filter. Remove the water filter and inspect. Clean if necessary.

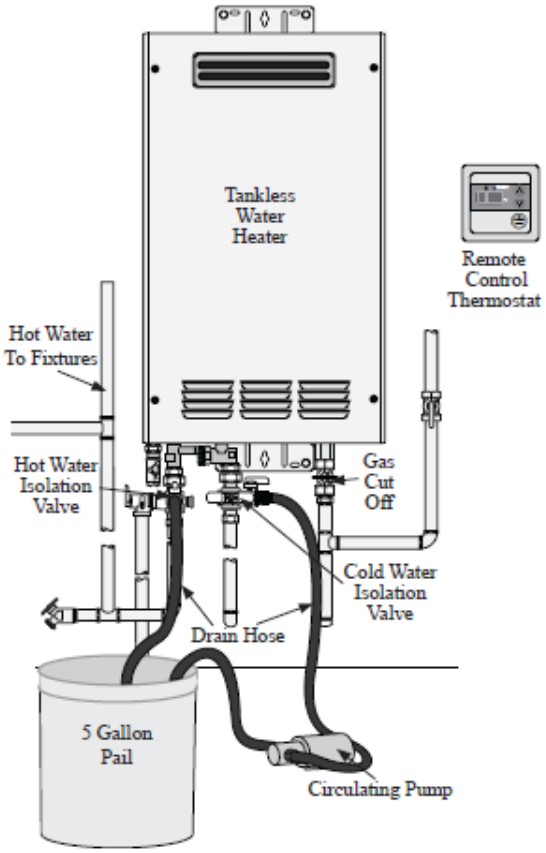
1L - Warning Code

Explanation: The Control Board has detected possible lime build-up inside the heat exchanger. To prevent permanent damage to the unit, the unit must be drained and flushed. Flushing procedures may need to be repeated for excessive lime and scale build-up. To reset 1L Code, hold down the MIN and MAX buttons at the same time for 10 seconds.

Lime and scale flushing procedure for tankless water heaters:

In areas with hard water conditions the tankless water heater can develop lime and scale deposits in the heat exchanger. These deposits can restrict the water flow and degrade the performance of your water heater. These instructions are to provide a safe and effective means to remove lime and scale build up in the heat exchanger of your tankless water heater. If you are not comfortable with this procedure, then seek the assistance of a plumbing professional.

Flushing Procedure with Isolation Valves: If your tankless water heater is not installed with isolation valves, it is recommended that you seek the assistance of a plumbing professional.



1. Turn off the electricity and gas, to the tankless water heater. Do not perform this procedure with power or gas turned on; damage to the water heater can occur.
2. Shut off the main water supply valve to the tankless water heater. Consult the instructions provided by the isolation valve manufacturer for specifics in using their valve assemblies.
3. Attach a small garden hose on each drain valve. Connect the cold water hose to the output of a small circulation pump. A pond pump or similar model can be used for this application.
4. Pour approximately five gallons of **virgin food grade white vinegar** into a pail.
5. Place the inlet hose of the pump and the drain hose from the hot water heater into the pail.
6. Open the drain valves and turn on the pump. Allow solution to circulate for approximately 45 minutes to an hour.
7. Turn off the pump and drain the vinegar from water heater. Close the cold water drain valve.
8. Open the main cold water supply valve and allow fresh water to flush through the water heater for at least 5 minutes to remove all traces of vinegar from the system.
9. Close the cold water main valve and remove water filter screen located in cold water inlet of water heater. Clean the screen of any sediment or dirt and reinstall the filter. See the Use and Care Manual provided with your tankless water heater for detailed instructions.
10. Turn on the water shutoff valves, run a hot water tap to purge any air from the water lines and check the system for any leaks.
11. Turn on gas, electricity, and remote control thermostat and set the desired temperature.
12. Run hot water from several locations to check the operation and performance of the water heater.

03 - Error Code

(Only for manifold installations utilizing EZ-Link; MIC-6; or MIC-185)

Explanation: Communication failure between water heaters, remote control, and/or manifold controller.

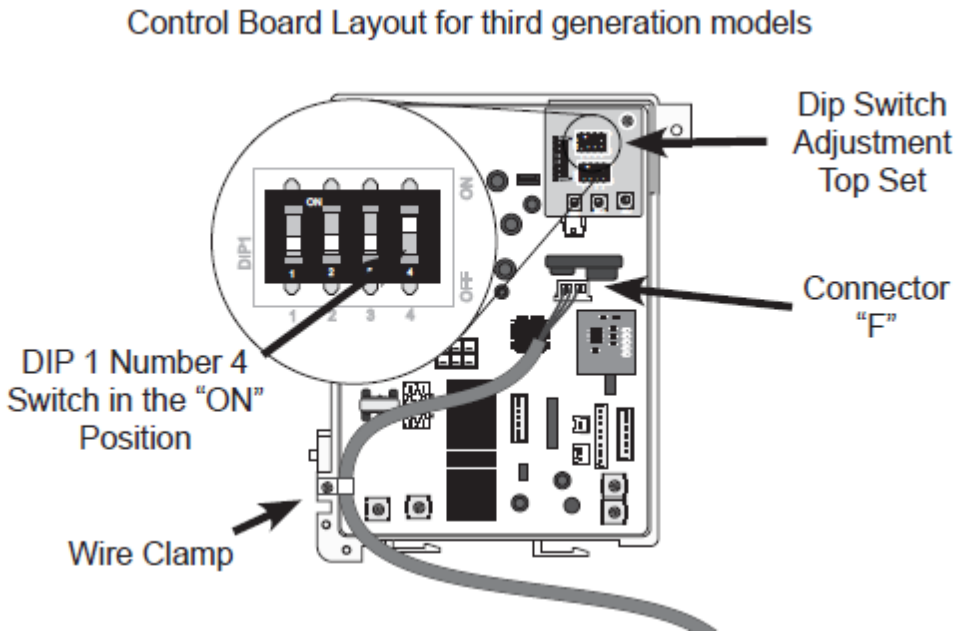
Diagnostic Checks:

- *DIP1 Setting On Main Control Board (PCB)*

DIP 1 SETTING:

Manifold units only: DIP #1, switch #4 must be in the 'ON' position for each unit

Check ALL Molex connections on ALL Control Boards



If Error Code 03 is displayed after completing all checks: Call Technical Support (800)-432-8373

05 – Warning Code

Explanation: The Flame Rod has detected improper burner combustion. The unit is NOT able to maintain the proper fuel/air mixture for proper combustion. This warning code is commonly caused by VENTING and/or GAS SUPPLY. The unit will continue to operate and attempt to resolve improper combustion, but may eventually shut down with an error code 11, 12, or 13.

Diagnostic Checks:

- *GAS SUPPLY & VENTING*
- *Dip #2 Setting On Printed Circuit Board (PCB)*

GAS SUPPLY & VENTING

****REFER TO USE & CARE MANUAL****

Make sure you have sufficient fuel for the unit to operate properly.

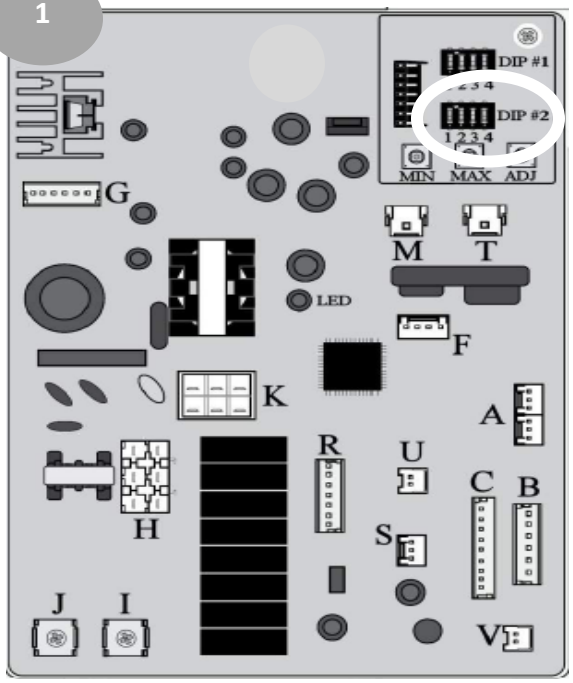
1. Gas Type (LP or Natural Gas)
2. Gas Pressure
3. Gas Pipe Size
4. Gas Flex Line Not To Exceed 36" In Length, Has The Proper ID (Inside Diameter), & Correct BTU Rating
5. Gas Regulator
6. Gas Shut Off Valves
7. Air In Gas Line

Visually inspect venting for possible blockage and/or recirculation of exhaust.

1. Approved Venting Materials
2. Approved Vent Terminations
3. Vent Lengths
4. Location Of Vent Termination (Recirculation of exhaust)
5. Blocked Venting
6. Venting Not Sealed Properly

DIP #2 SETTING:

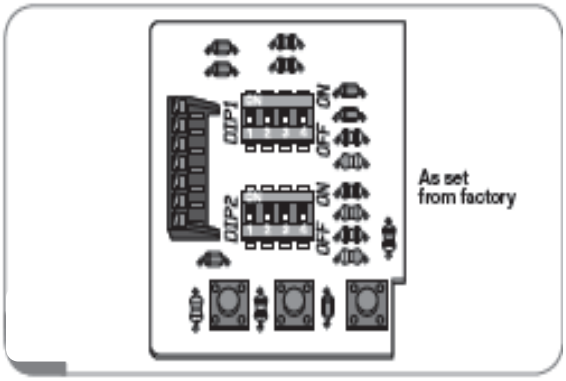
1



Locate the two DIP switches at top right of PCB.
Switch labeled DIP #2 is the bottom switch.
DO NOT ALTER ANY OTHER SWITCHES

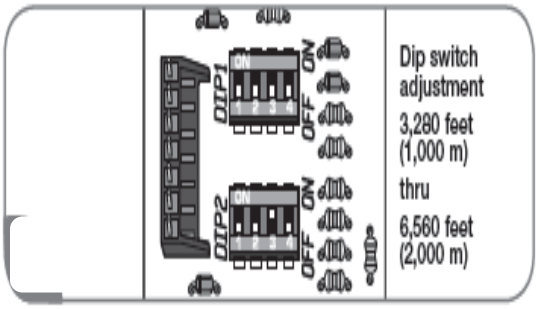
2

Sea Level to 3,280 Feet



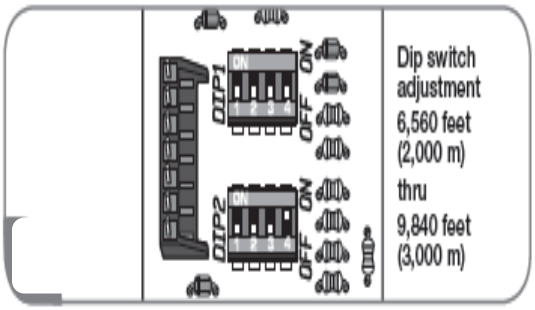
The factory settings for this switch should all be in the OFF position (DOWN).

3



If altitude is above 3,280 ft. (1,000 m) and below 6,560 ft. (2,000 m), change the third switch on "DIP 2" to the ON position (UP).

4



If altitude is above 6,560 ft. (2,000 m) and below 9,840 ft. (3,000 m), change the fourth switch to the ON position (UP).

NOTES:

10 – Warning Code

Explanation: The Blower Motor is not creating enough ventilation. The system passed the pre-purge cycle, but detects vent blockage during normal operation. The unit will continue to operate but may eventually shut down with Error Code 99.

First check your GAS SUPPLY & VENTING; the most common causes for Error Code 10.

Diagnostic Checks:

- GAS SUPPLY & VENTING
- Blower Motor

GAS SUPPLY & VENTING
****REFER TO USE & CARE MANUAL****

Make sure you have sufficient fuel for the unit to operate properly.

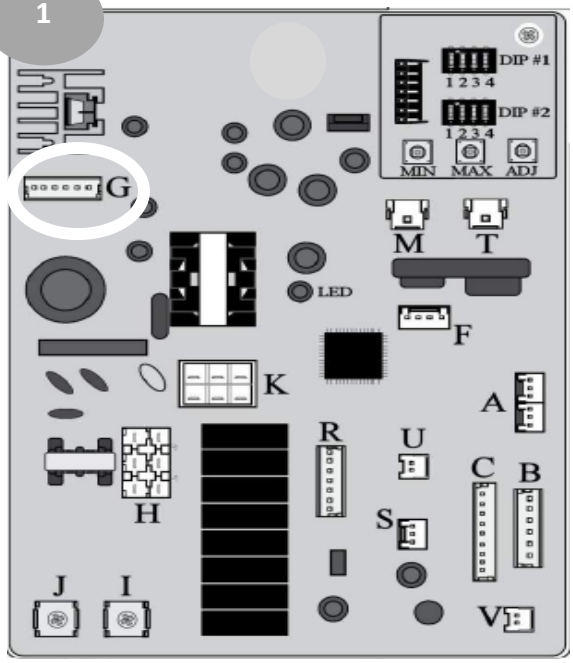
1. Gas Type (LP or Natural Gas)
2. Gas Pressure
3. Gas Pipe Size
4. Gas Flex Line Not To Exceed 36” In Length, has the proper ID (Inside Diameter), and correct BTU rating
5. Gas Regulator
6. Gas Shut Off Valves
7. Air In Gas Line

Visually inspect venting for possible blockage and/or recirculation of exhaust.

1. Approved Venting Materials
2. Approved Vent Terminations
3. Vent Lengths
4. Location Of Vent Termination (Recirculation of exhaust)
5. Blocked Venting
6. Venting Not Sealed Properly

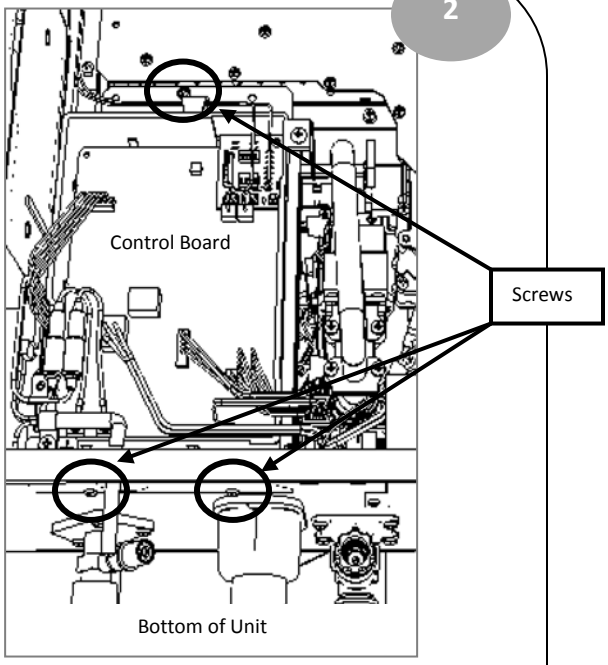
***BLOWER MOTOR DIAGNOSTICS*:**

1



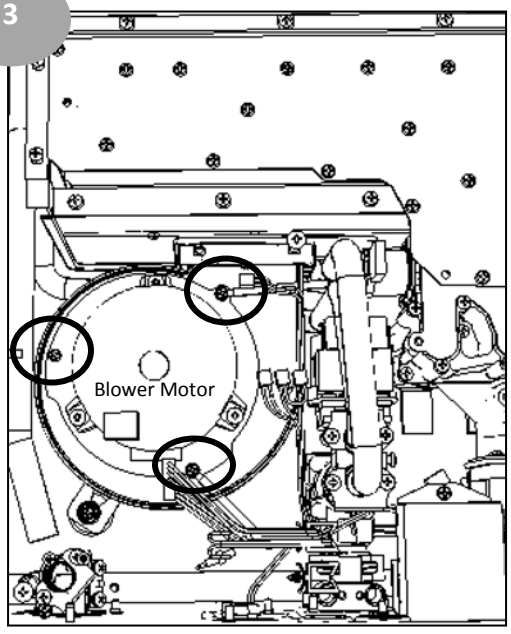
Turn power OFF. Remove and reinsert connector "G" on Control Board. Attempt to operate unit again. IF 10 Warning Code does NOT display, unit had a loose connection.

2



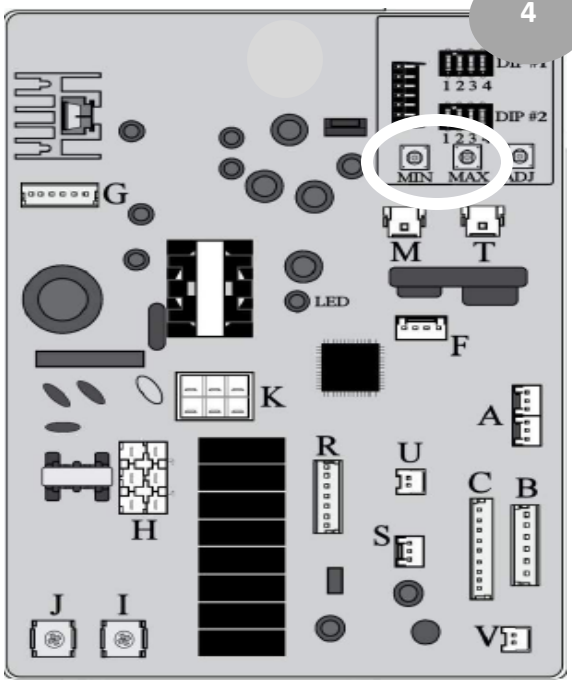
Turn power OFF. Remove 3 screws for Control Board mounting bracket. Remove connectors "M", "T", & "G". Pull PCB out of way to access Blower Motor.

3



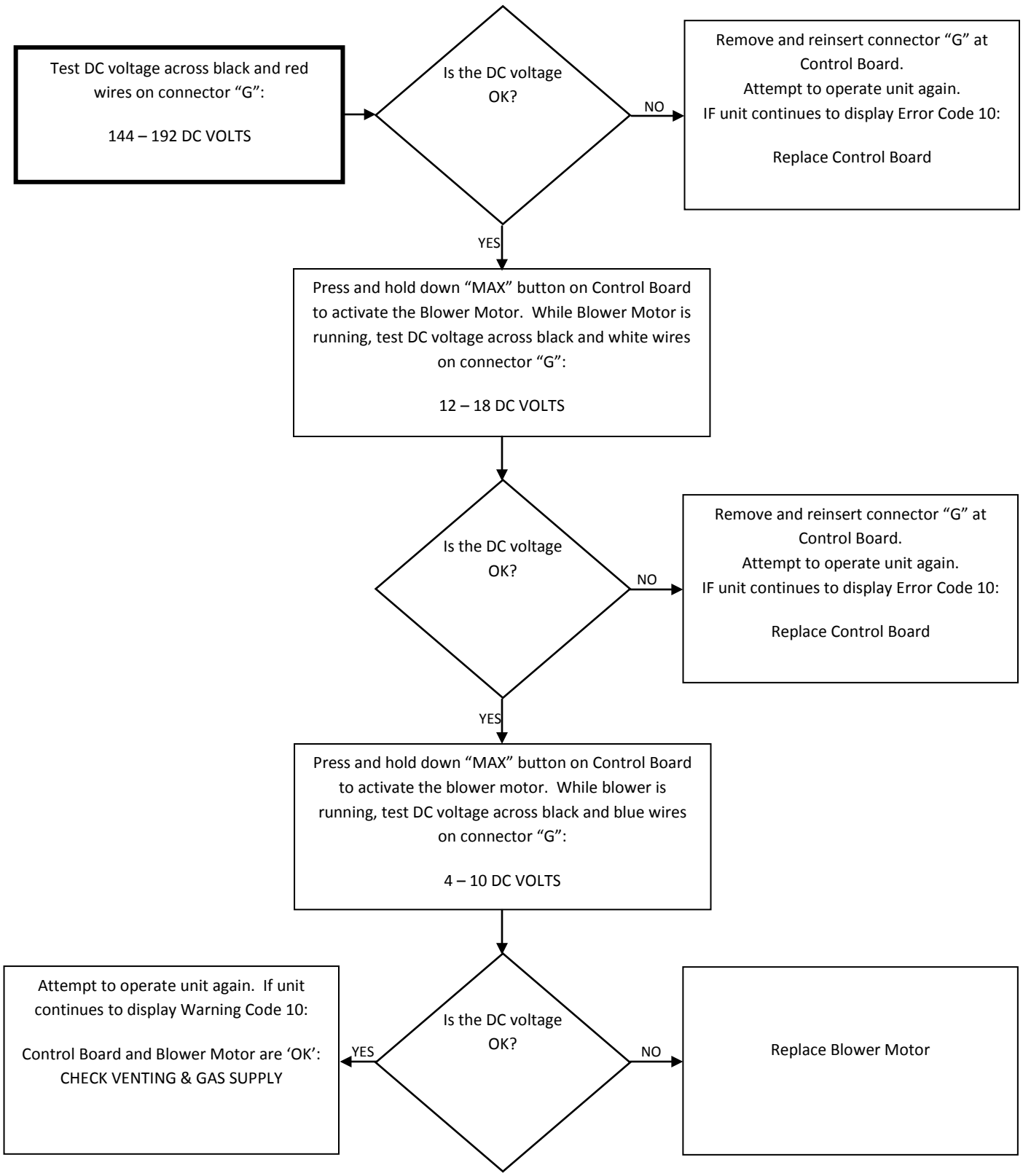
Remove 3 screws holding Blower Motor in place. Clean Blower Motor and reassemble unit. Attempt to operate unit again. IF 10 Warning Code does NOT display: Blower Motor needed to be cleaned.

4



Locate Min & Max buttons on Control Board. Continue to diagnostic chart on next page.

10 – Warning Code Diagnostic Chart


Test DC voltage across black and red wires on connector "G":
144 – 192 DC VOLTS
Is the DC voltage OK?
NO
Remove and reinsert connector "G" at Control Board.
Attempt to operate unit again.
IF unit continues to display Error Code 10:
Replace Control Board
YES
Press and hold down "MAX" button on Control Board to activate the Blower Motor. While Blower Motor is running, test DC voltage across black and white wires on connector "G":
12 – 18 DC VOLTS
Is the DC voltage OK?
NO
Remove and reinsert connector "G" at Control Board.
Attempt to operate unit again.
IF unit continues to display Error Code 10:
Replace Control Board
YES
Press and hold down "MAX" button on Control Board to activate the blower motor. While blower is running, test DC voltage across black and blue wires on connector "G":
4 – 10 DC VOLTS
Is the DC voltage OK?
YES
Attempt to operate unit again. If unit continues to display Warning Code 10:
Control Board and Blower Motor are 'OK':
CHECK VENTING & GAS SUPPLY
NO
Replace Blower Motor

NOTES:

11 – Error Code

Explanation: This error code is commonly a result of GAS SUPPLY and/or VENTING. Flame Rod(s) does not detect flame. This Is caused by the following: Inadequate GAS SUPPLY; Inadequate VENTING; Igniter Rod NOT sparking; Build-up on Flame Rod(s) caused by inadequate GAS SUPPLY and/or VENTING; Gas Valve.

IMPORTANT: If all water heater components test 'OK', you must thoroughly inspect your GAS SUPPLY & VENTING.

First Check: GAS SUPPLY & VENTING

Diagnostic Checks:

- GAS SUPPLY & VENTING
- Igniter Rod
- Flame Rod(s)
- Gas Control Valve

GAS SUPPLY & VENTING
****REFER TO USE & CARE MANUAL****

Make sure you have sufficient fuel for the unit to operate properly.

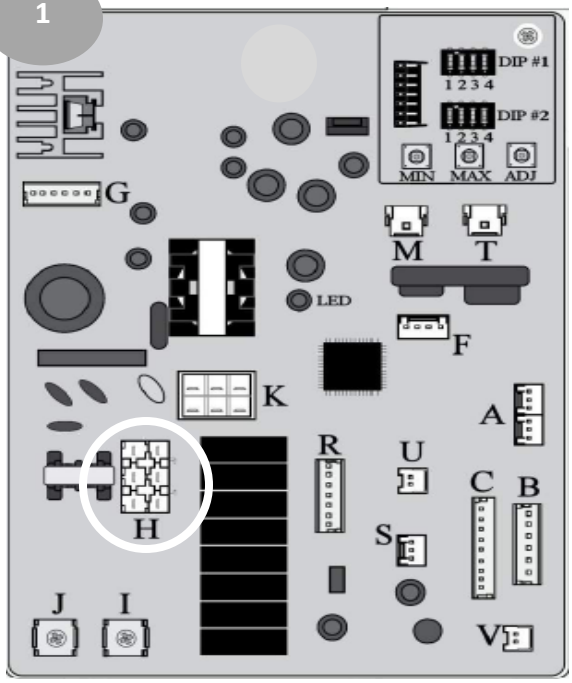
1. Gas Type (LP or Natural Gas)
2. Gas Pressure
3. Gas Pipe Size
4. Gas Flex Line Not To Exceed 36" In Length, has the proper ID (Inside Diameter), and correct BTU rating
5. Gas Regulator
6. Gas Shut Off Valves
7. Air In Gas Line

Visually inspect venting for possible blockage and/or recirculation of exhaust.

1. Approved Venting Materials
2. Approved Vent Terminations
3. Vent Lengths
4. Location Of Vent Termination (Recirculation of exhaust)
5. Blocked Venting
6. Venting Not Sealed Properly

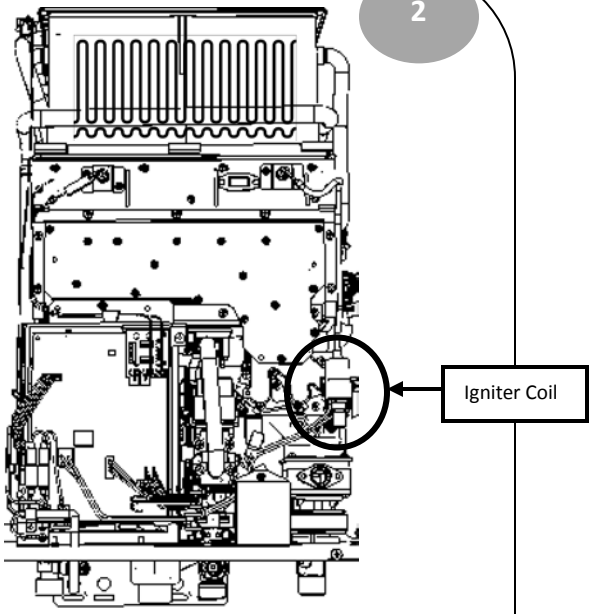
IGNITER ROD DIAGNOSTICS: (spark is NOT visible)

1



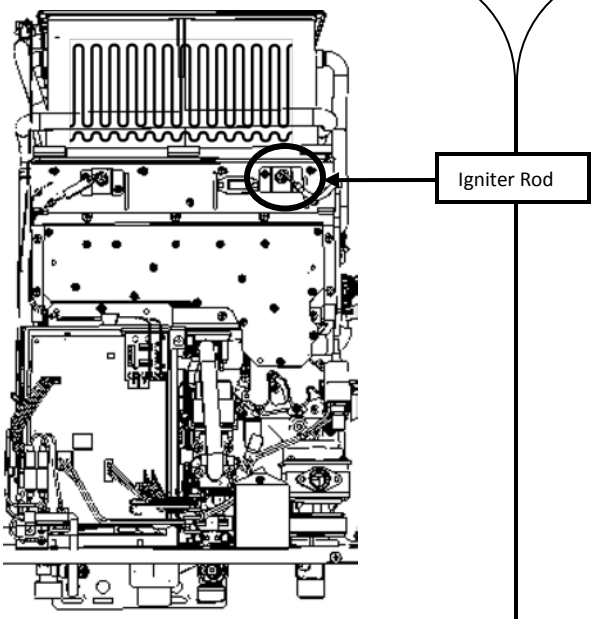
Turn power OFF. Remove and reinsert connector "H" on Control Board.

2



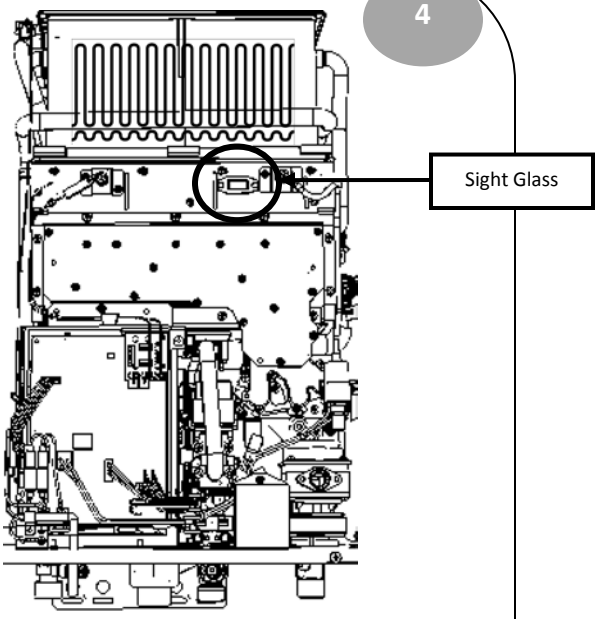
Remove and reinsert white Molex connector at Igniter Coil mounted on right side of unit.

3



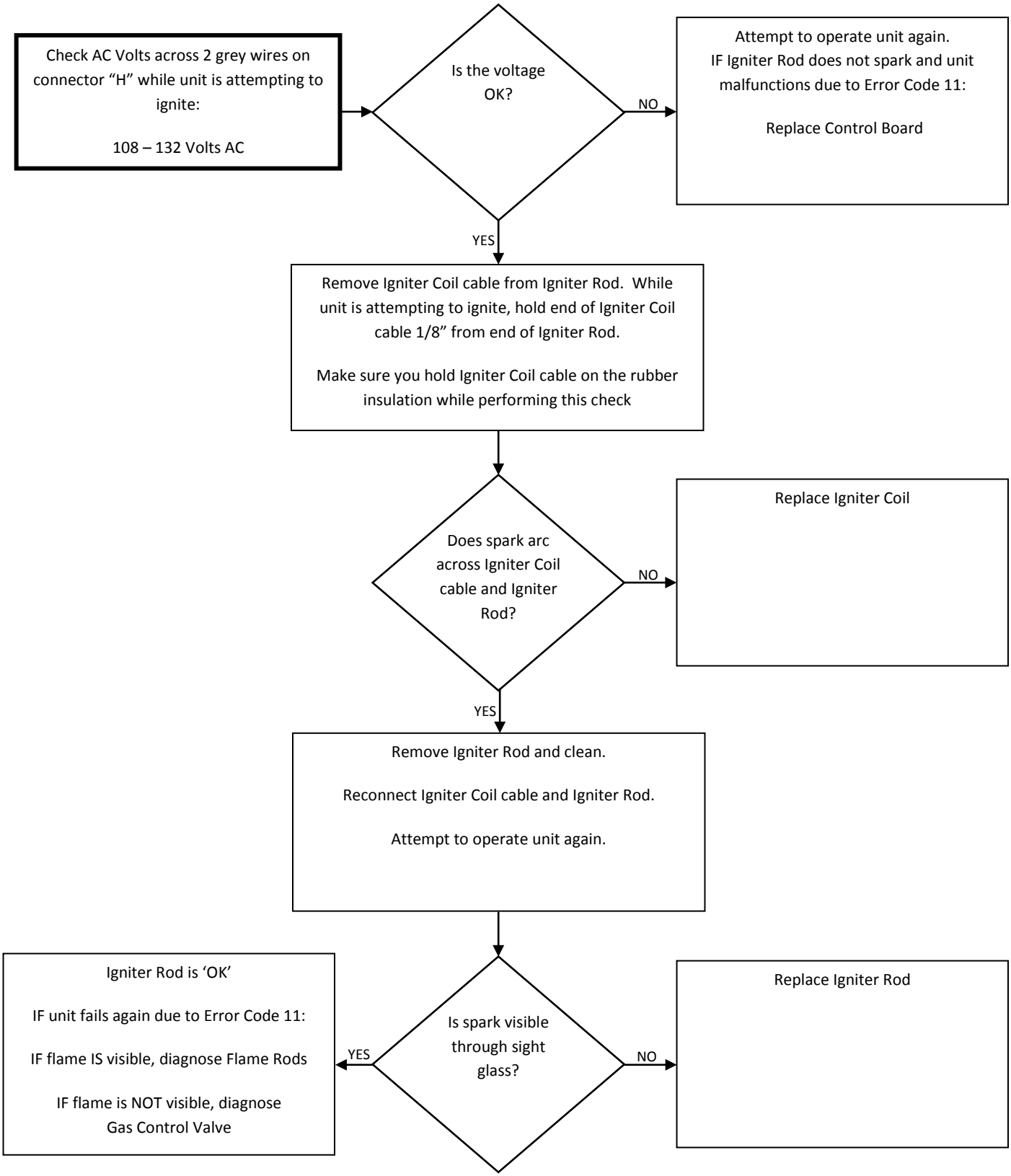
Remove and reinsert Igniter Coil cable on Igniter Rod. Turn power ON.

4



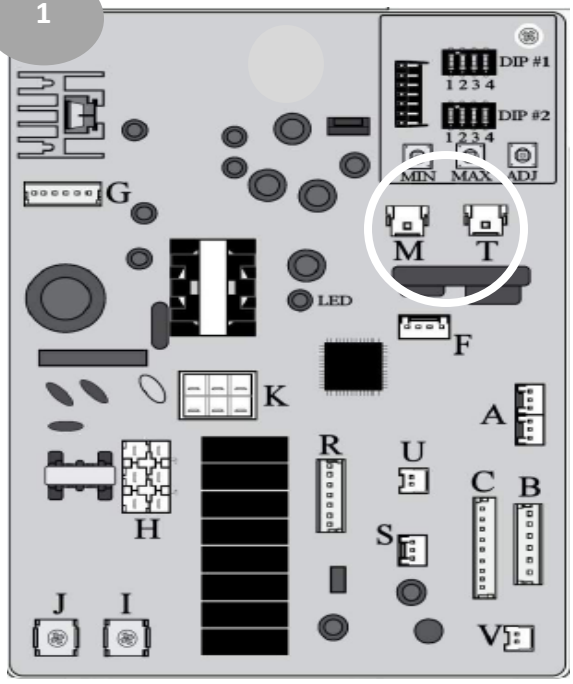
While unit is attempting to ignite, determine IF spark is visible through sight glass. IF YES, unit had a loose connection. IF NO, continue to diagnostic chart on next page.

IGNITER ROD Diagnostic Chart


Check AC Volts across 2 grey wires on connector "H" while unit is attempting to ignite:
108 – 132 Volts AC
Is the voltage OK?
NO
Attempt to operate unit again.
IF Igniter Rod does not spark and unit malfunctions due to Error Code 11:
Replace Control Board
YES
Remove Igniter Coil cable from Igniter Rod. While unit is attempting to ignite, hold end of Igniter Coil cable 1/8" from end of Igniter Rod.
Make sure you hold Igniter Coil cable on the rubber insulation while performing this check
Does spark arc across Igniter Coil cable and Igniter Rod?
NO
Replace Igniter Coil
YES
Remove Igniter Rod and clean.
Reconnect Igniter Coil cable and Igniter Rod.
Attempt to operate unit again.
Is spark visible through sight glass?
YES
Igniter Rod is 'OK'
IF unit fails again due to Error Code 11:
IF flame IS visible, diagnose Flame Rods
IF flame is NOT visible, diagnose Gas Control Valve
NO
Replace Igniter Rod

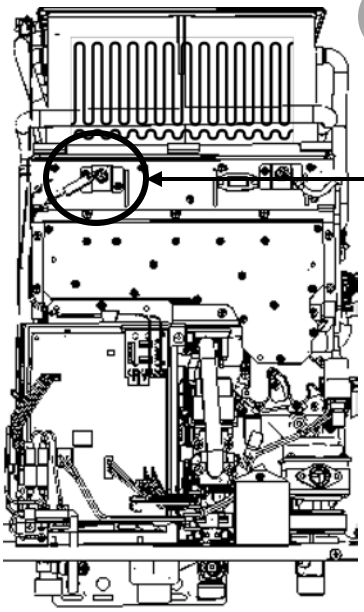
FLAME ROD(S) DIAGNOSTICS: (flame IS visible)

1



Turn power OFF. Remove and reinsert white connector "M" and blue connector "T" on Control Board.

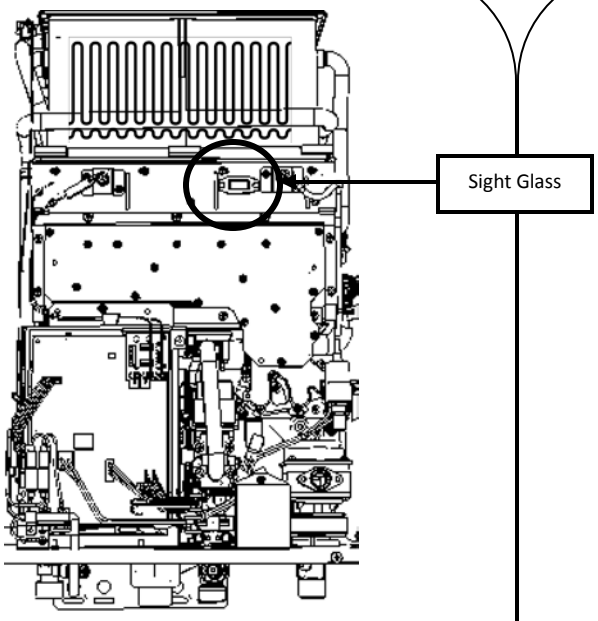
2



Remove and reinsert terminals on Flame Rods(s)*. Attempt to operate unit again. IF 11 Error Code does NOT display, unit had a loose connection.

*Indoor Models ONLY:
2 Flame Rods

3

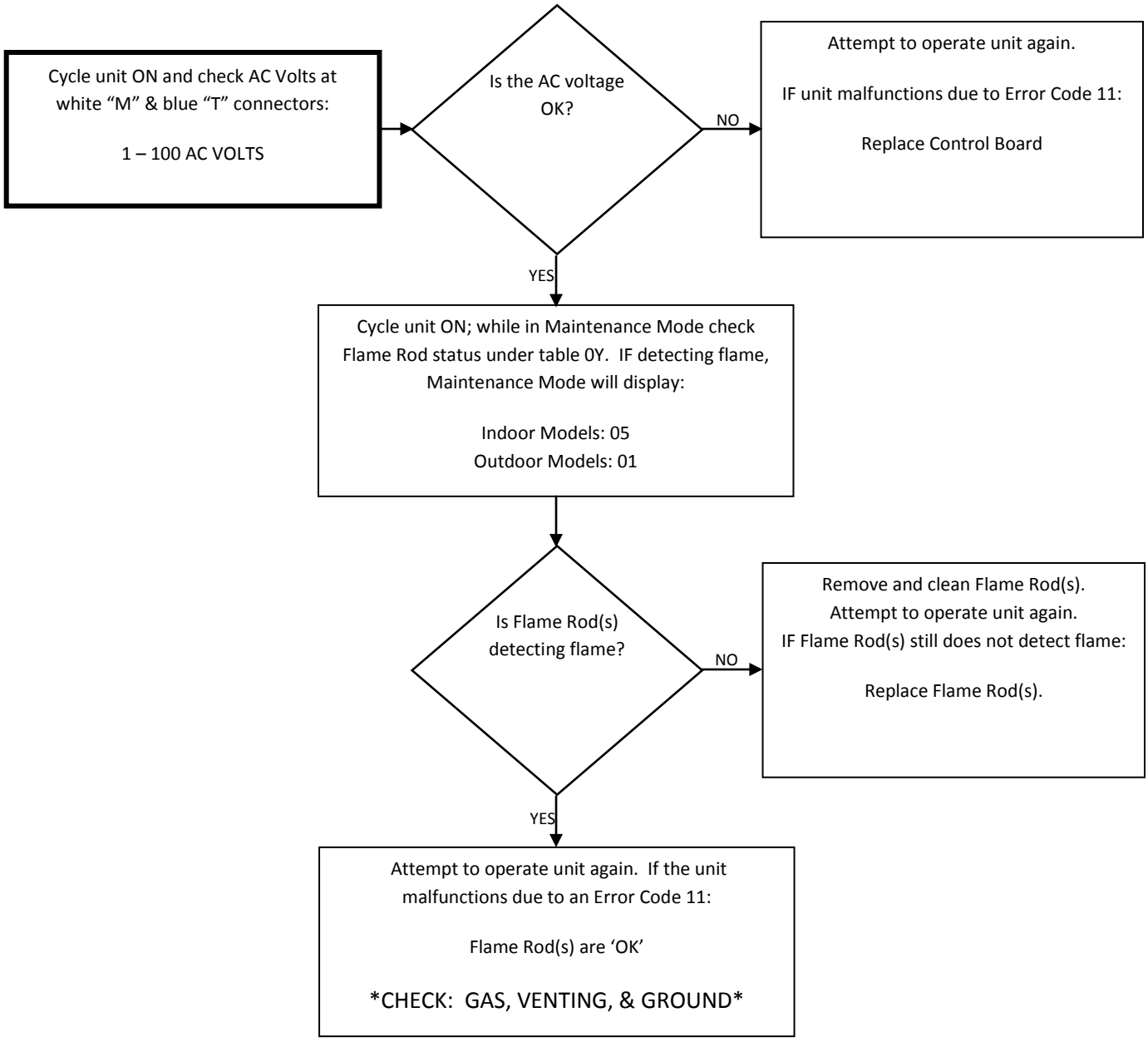


Locate sight glass. While unit is attempting to ignite, determine if flame is touching Flame Rod(s). IF NO, remove any foreign debris. IF foreign debris NOT present: CHECK GAS SUPPLY & VENTING.

4

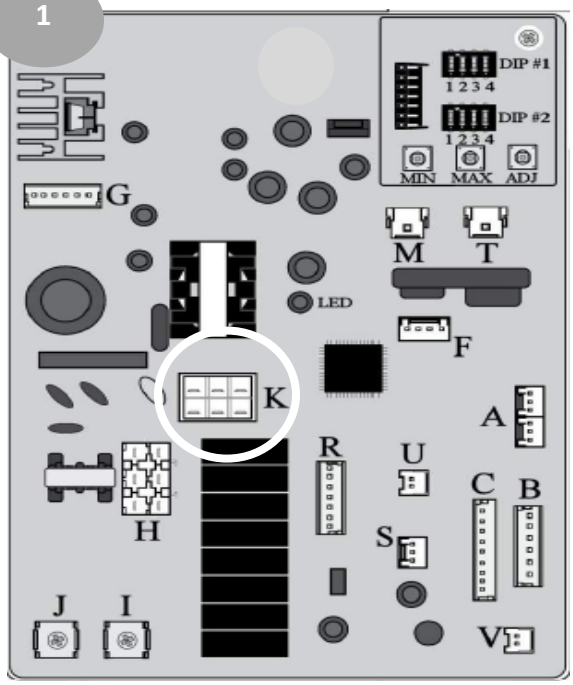
On Remote Control; go to Maintenance Mode 0Y table.
For Maintenance Mode instructions go to page 16.
Continue to diagnostic chart on next page.

FLAME ROD(s) Diagnostic Chart


Cycle unit ON and check AC Volts at white "M" & blue "T" connectors:
1 – 100 AC VOLTS
Is the AC voltage OK?
NO
Attempt to operate unit again.
IF unit malfunctions due to Error Code 11:
Replace Control Board
YES
Cycle unit ON; while in Maintenance Mode check Flame Rod status under table 0Y. IF detecting flame, Maintenance Mode will display:
Indoor Models: 05
Outdoor Models: 01
Is Flame Rod(s) detecting flame?
NO
Remove and clean Flame Rod(s).
Attempt to operate unit again.
IF Flame Rod(s) still does not detect flame:
Replace Flame Rod(s).
YES
Attempt to operate unit again. If the unit malfunctions due to an Error Code 11:
Flame Rod(s) are 'OK'
CHECK: GAS, VENTING, & GROUND

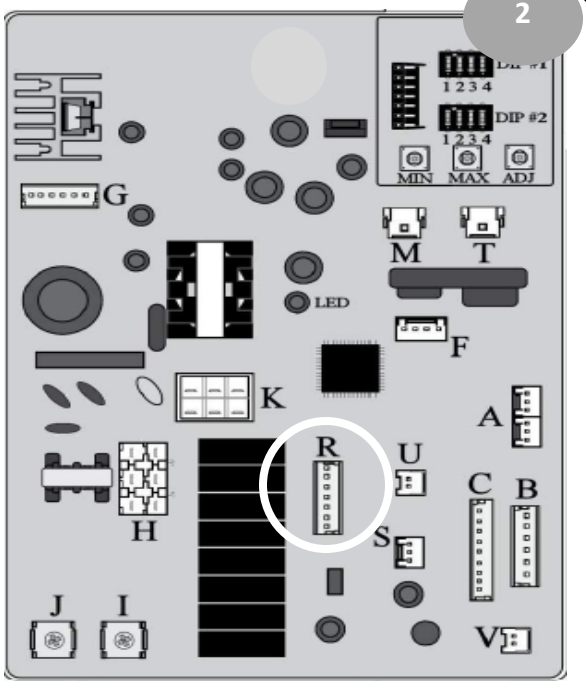
GAS CONTROL VALVE DIAGNOSTICS: (Igniter Rod DOES spark & NO flame)

1



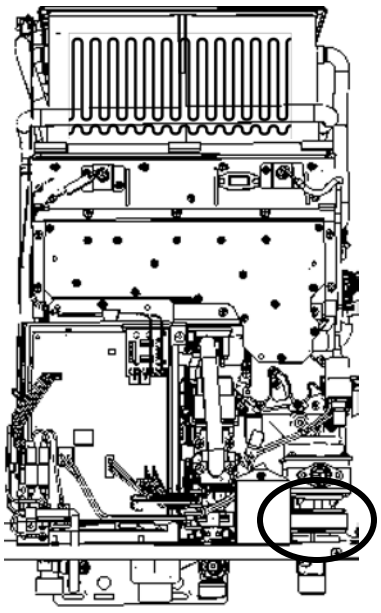
Turn power OFF. Remove and reinsert connector “K” on Control Board.

2



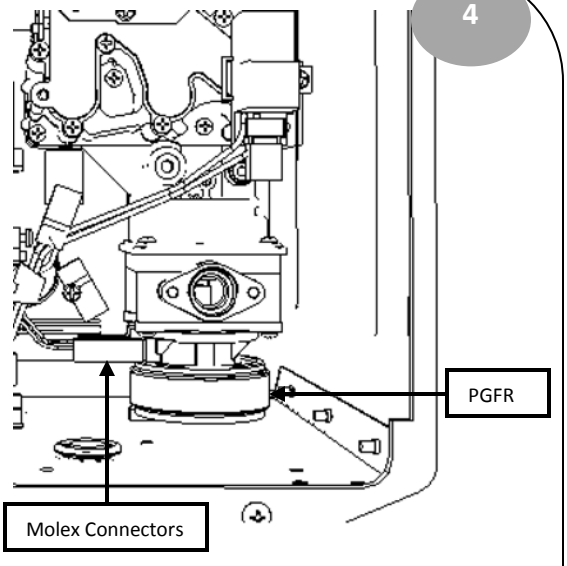
Remove and reinsert connector “R” on Control Board.

3



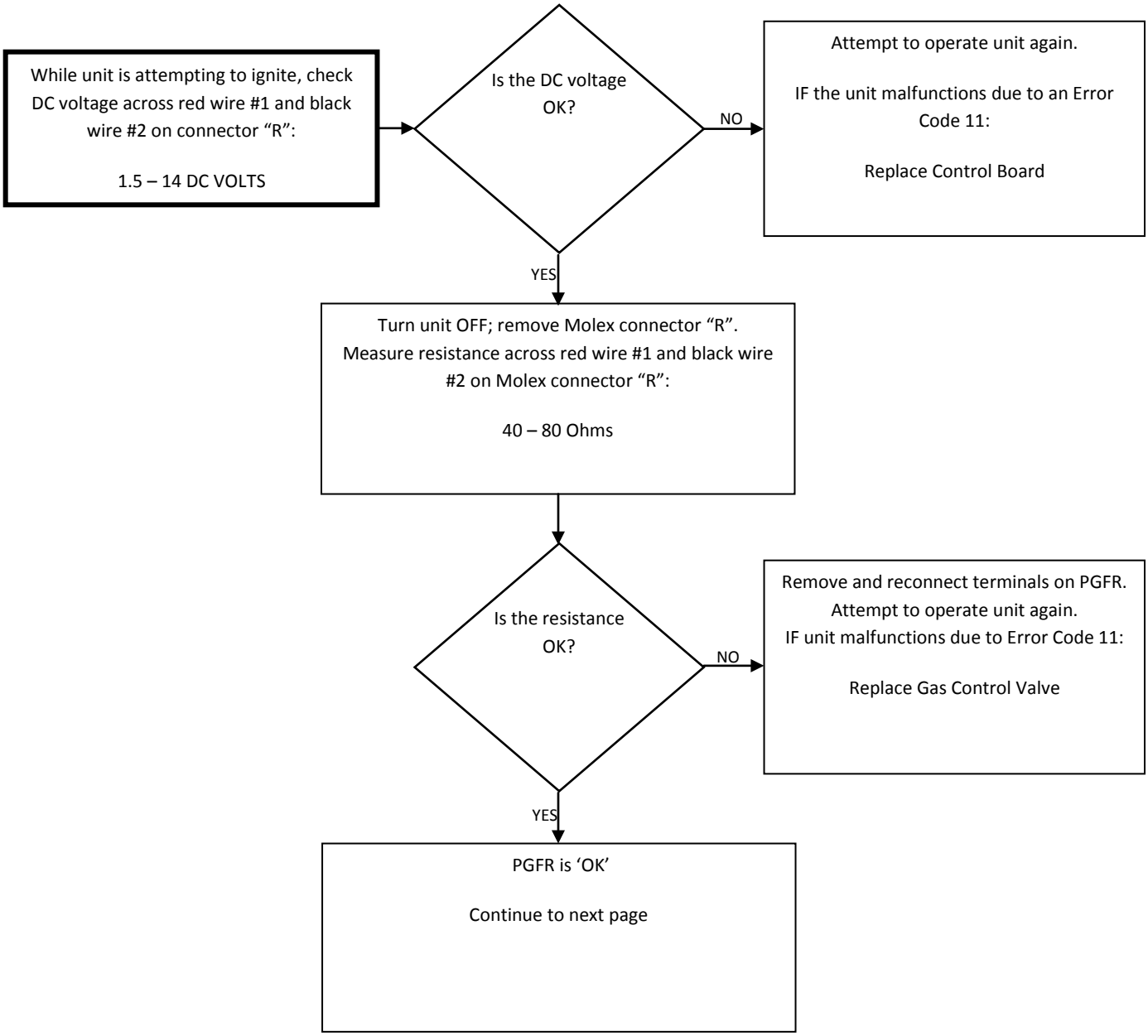
Locate PGFR valve on lower right of unit. Remove and reinsert Molex connector with red wire and Molex connector with black wire on PGFR.
Attempt to operate unit again.

4

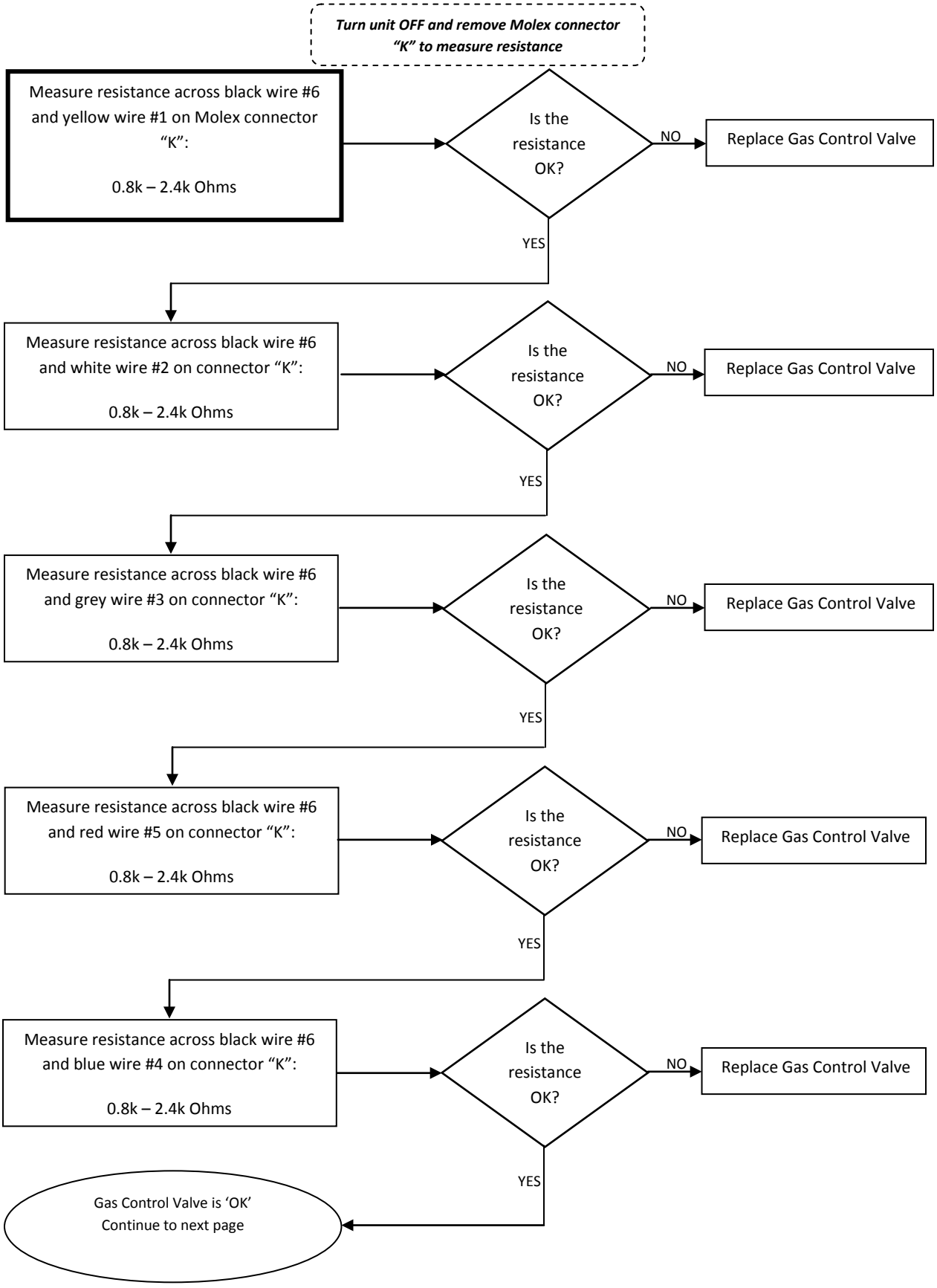


IF 11 Error Code does NOT display, unit had a loose connection.
IF 11 Error Code IS displayed, continue to diagnostic chart on next page.

GAS CONTROL VALVE Diagnostic Chart

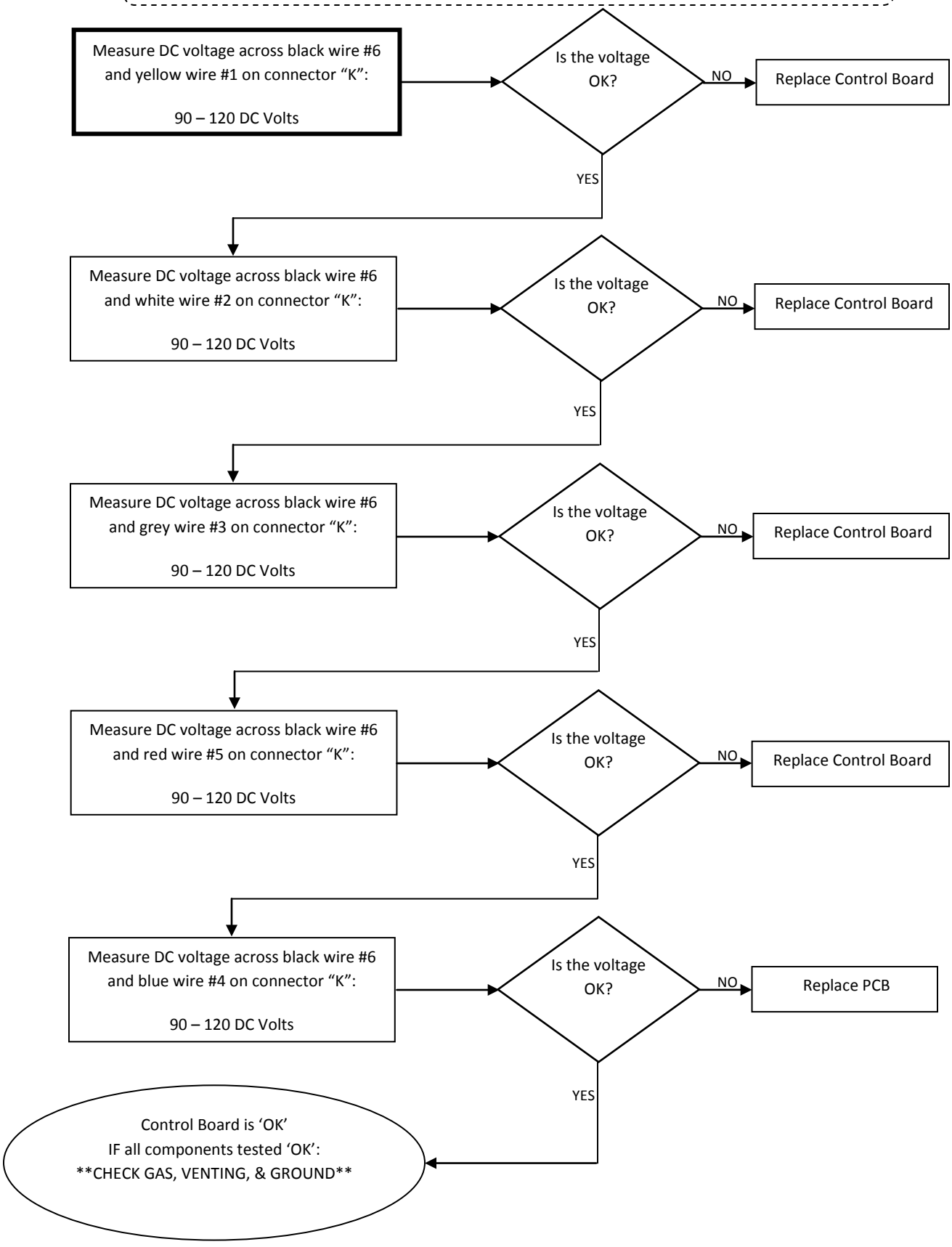

While unit is attempting to ignite, check DC voltage across red wire #1 and black wire #2 on connector "R":
1.5 – 14 DC VOLTS
Is the DC voltage OK?
NO
Attempt to operate unit again.
IF the unit malfunctions due to an Error Code 11:
Replace Control Board
YES
Turn unit OFF; remove Molex connector "R". Measure resistance across red wire #1 and black wire #2 on Molex connector "R":
40 – 80 Ohms
Is the resistance OK?
NO
Remove and reconnect terminals on PGFR. Attempt to operate unit again.
IF unit malfunctions due to Error Code 11:
Replace Gas Control Valve
YES
PGFR is 'OK'
Continue to next page

GAS CONTROL VALVE Diagnostic Chart


Turn unit OFF and remove Molex connector "K" to measure resistance
Measure resistance across black wire #6 and yellow wire #1 on Molex connector "K":
0.8k – 2.4k Ohms
Is the resistance OK?
NO
Replace Gas Control Valve
YES
Measure resistance across black wire #6 and white wire #2 on connector "K":
0.8k – 2.4k Ohms
Is the resistance OK?
NO
Replace Gas Control Valve
YES
Measure resistance across black wire #6 and grey wire #3 on connector "K":
0.8k – 2.4k Ohms
Is the resistance OK?
NO
Replace Gas Control Valve
YES
Measure resistance across black wire #6 and red wire #5 on connector "K":
0.8k – 2.4k Ohms
Is the resistance OK?
NO
Replace Gas Control Valve
YES
Measure resistance across black wire #6 and blue wire #4 on connector "K":
0.8k – 2.4k Ohms
Is the resistance OK?
NO
Replace Gas Control Valve
YES
Gas Control Valve is 'OK'
Continue to next page

CONTROL BOARD Diagnostic Chart

All voltage checks must be performed while unit is attempting to go to main burner and Molex connector "K" IS connected to Control Board. Restart unit after each voltage check.


Measure DC voltage across black wire #6 and yellow wire #1 on connector "K":
90 – 120 DC Volts
Is the voltage OK?
NO
Replace Control Board
YES
Measure DC voltage across black wire #6 and white wire #2 on connector "K":
90 – 120 DC Volts
Is the voltage OK?
NO
Replace Control Board
YES
Measure DC voltage across black wire #6 and grey wire #3 on connector "K":
90 – 120 DC Volts
Is the voltage OK?
NO
Replace Control Board
YES
Measure DC voltage across black wire #6 and red wire #5 on connector "K":
90 – 120 DC Volts
Is the voltage OK?
NO
Replace Control Board
YES
Measure DC voltage across black wire #6 and blue wire #4 on connector "K":
90 – 120 DC Volts
Is the voltage OK?
NO
Replace PCB
YES
Control Board is 'OK'
IF all components tested 'OK':
CHECK GAS, VENTING, & GROUND

NOTES:

12 – Error Code

Explanation: Commonly a result of inadequate GAS SUPPLY. Unit detected the presence of flame then Flame Rod lost flame recognition.

Diagnostic Checks:

- GAS SUPPLY & VENTING
- Flame Rod(s)

First Check: *GAS SUPPLY & VENTING*

GAS SUPPLY & VENTING
****REFER TO USE & CARE MANUAL****

Make sure you have sufficient fuel for the unit to operate properly.

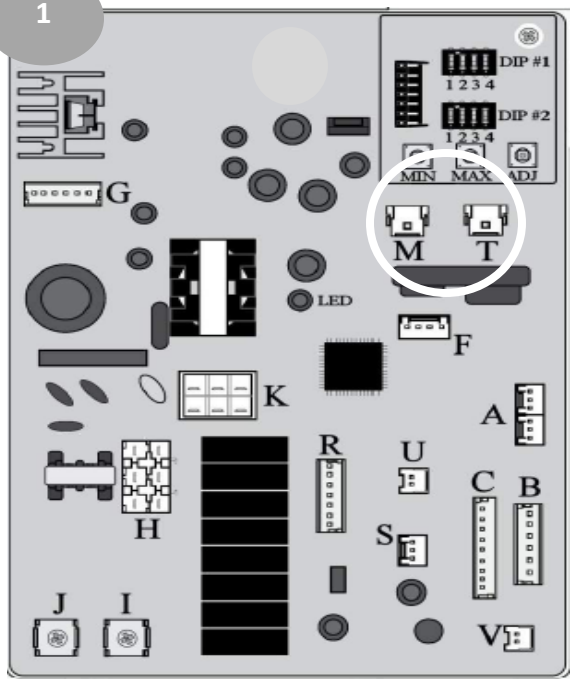
1. Gas Type (LP or Natural Gas)
2. Gas Pressure
3. Gas Pipe Size
4. Gas Flex Line Not To Exceed 36” In Length, has the proper ID (Inside Diameter), and correct BTU rating
5. Gas Regulator
6. Gas Shut Off Valves
7. Air In Gas Line

Visually inspect venting for possible blockage and/or recirculation of exhaust.

1. Approved Venting Materials
2. Approved Vent Terminations
3. Vent Lengths
4. Location Of Vent Termination (Recirculation of exhaust)
5. Blocked Venting
6. Venting Not Sealed Properly

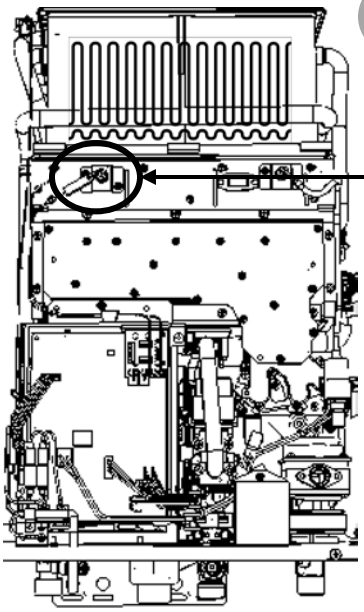
FLAME ROD(S) DIAGNOSTICS: (flame IS visible)

1



Turn power OFF. Remove and reinsert white connector "M" and blue connector "T" on Control Board.

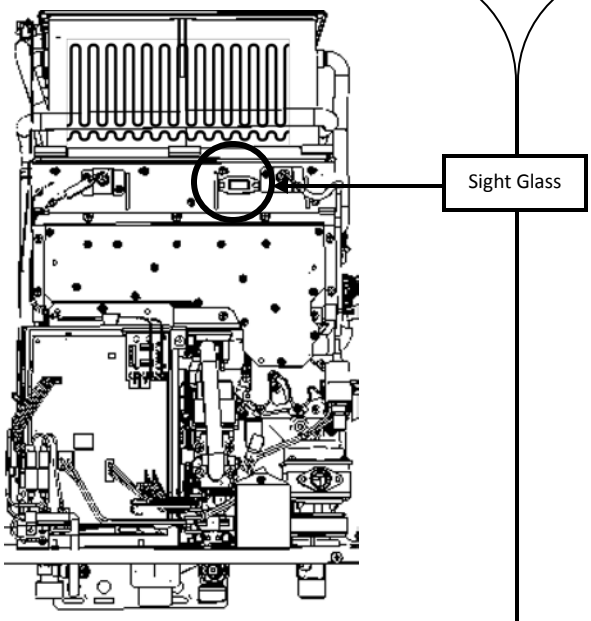
2



Remove and reinsert terminals on Flame Rod(s)*. Attempt to operate unit again. IF 12 Error Code does NOT display, unit had a loose connection.

*Indoor Models ONLY: 2 Flame Rods

3

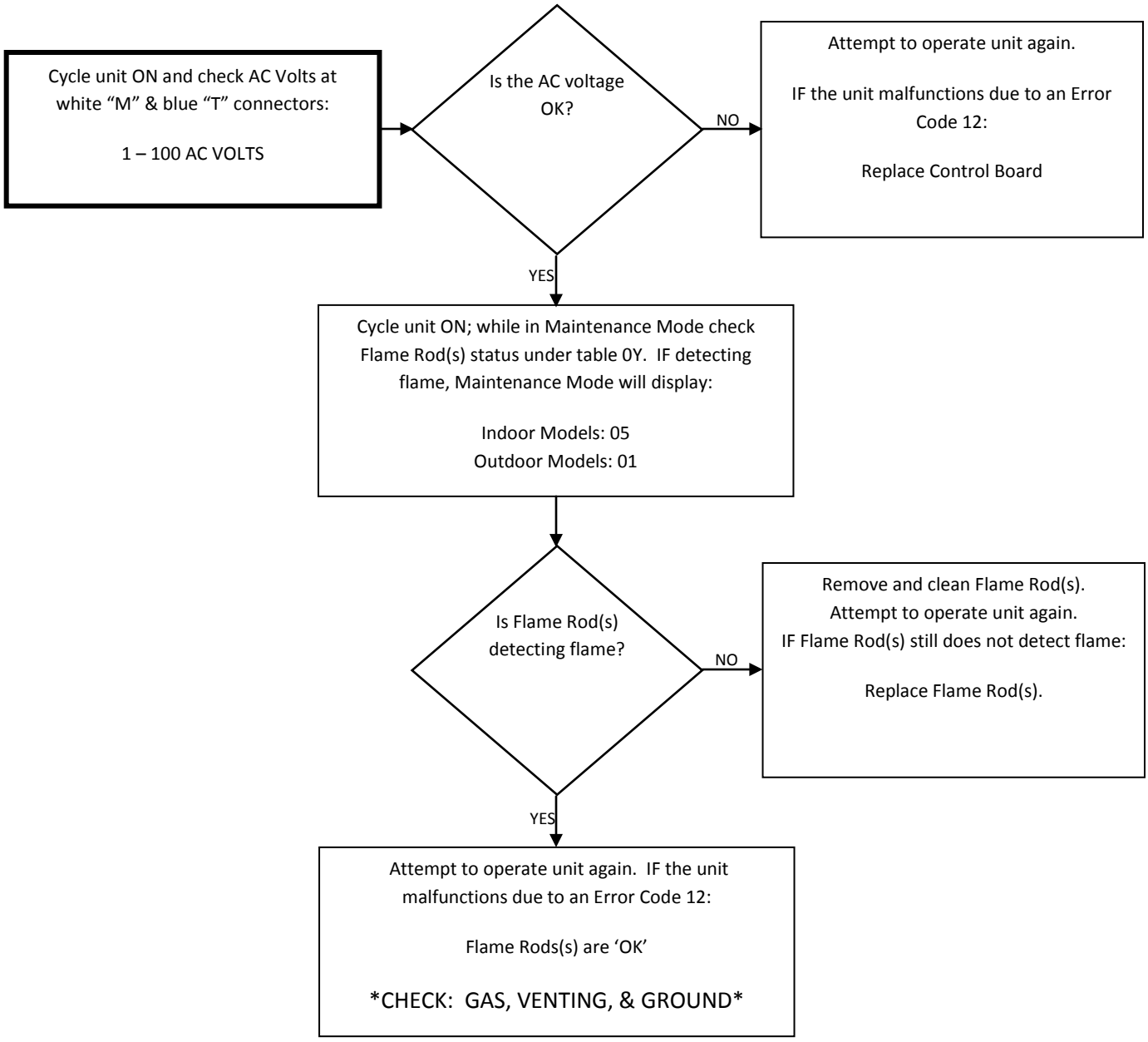


Locate sight glass. While unit is attempting to ignite, determine if flame is touching Flame Rod(s). IF NO, remove any foreign debris. IF foreign debris NOT present: CHECK GAS SUPPLY & VENTING.

4

On Remote Control; go to Maintenance Mode 0Y table. For Maintenance Mode instructions go to page 16. Continue to diagnostic chart on next page.

FLAME ROD(s) Diagnostic Chart


Cycle unit ON and check AC Volts at white "M" & blue "T" connectors:
1 – 100 AC VOLTS
Is the AC voltage OK?
NO
Attempt to operate unit again.
IF the unit malfunctions due to an Error Code 12:
Replace Control Board
YES
Cycle unit ON; while in Maintenance Mode check Flame Rod(s) status under table 0Y. IF detecting flame, Maintenance Mode will display:
Indoor Models: 05
Outdoor Models: 01
Is Flame Rod(s) detecting flame?
NO
Remove and clean Flame Rod(s).
Attempt to operate unit again.
IF Flame Rod(s) still does not detect flame:
Replace Flame Rod(s).
YES
Attempt to operate unit again. IF the unit malfunctions due to an Error Code 12:
Flame Rods(s) are 'OK'
CHECK: GAS, VENTING, & GROUND

NOTES:

13 – Error Code

Explanation: Indoor units ONLY. Flame Rod 2 (FL #2) is detecting poor combustion. This is commonly caused by inadequate or improperly installed VENTING (venting includes fresh air intake and exhaust). Other possible causes: Poor or NO ground connection; dirty or defective FL #2.
***If unit shuts down 5 times within a 4 hour period due to an error code 13, the unit must be reset by performing reset procedure on page 21.**

First Check: VENTING (Primary cause is blockage of the Fresh Air Intake Vent)

Diagnostic Checks:

- VENTING & GAS SUPPLY (always check gas supply at MAX BTU's) **REFER TO USE & CARE MANUAL**
- Ground Connection
- Flame Rod FL-2

VENTING:

Visually inspect venting for possible blockage and/or recirculation of exhaust.

1. Approved Venting Materials
2. Approved Vent Terminations
3. Vent Lengths
4. Location Of Vent Termination (Recirculation of exhaust)
5. Blocked Venting
6. Venting Not Sealed Properly

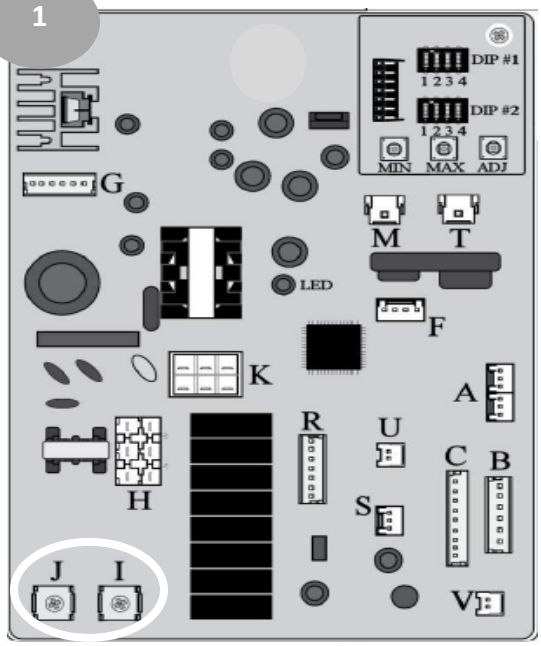
GAS SUPPLY:

Make sure you have sufficient fuel for the unit to operate properly.

1. Gas Type (LP or Natural Gas)
2. Gas Pressure
3. Gas Pipe Size
4. Gas Flex Line Not To Exceed 36" In Length, has the proper ID (Inside Diameter), and correct BTU rating
5. Gas Regulator
6. Gas Shut Off Valves
7. Air In Gas Line

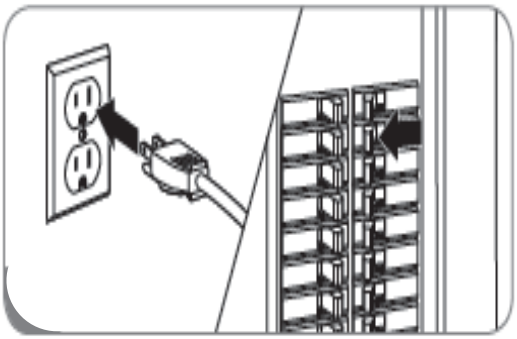
***GROUND CONNECTION DIAGNOSTICS*:**

1



Locate and visually inspect green ground wire connections on lower left side of PCB.
Ensure the wires are connected properly and not damaged.

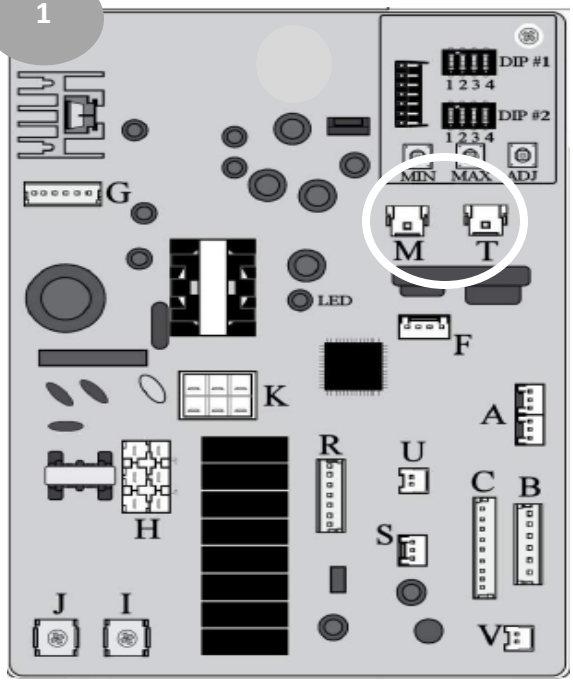
2



Ensure you have a proper ground at power supply to unit.

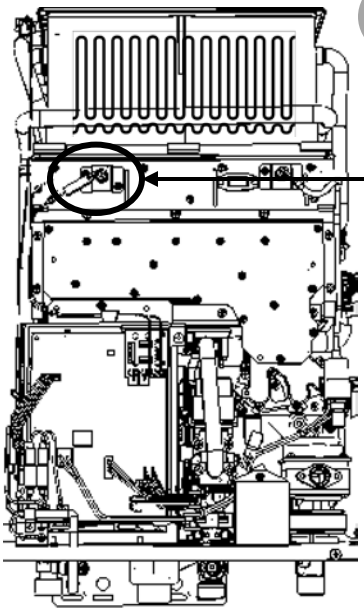
FLAME ROD(S) DIAGNOSTICS: (flame IS visible)

1



Turn power OFF. Remove and reinsert white connector "M" and blue connector "T" on Control Board.

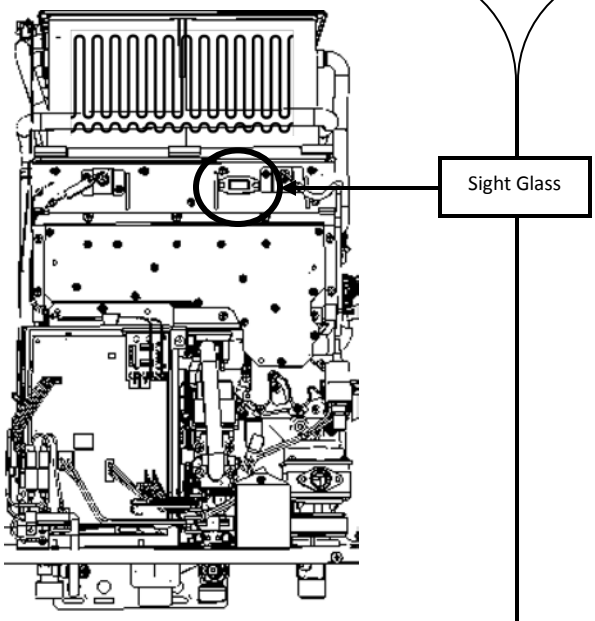
2



Remove and reinsert terminals on Flame Rod(s)*. Attempt to operate unit again. IF 13 Error Code does NOT display, unit had a loose connection.

*Indoor Models ONLY: 2 Flame Rods

3

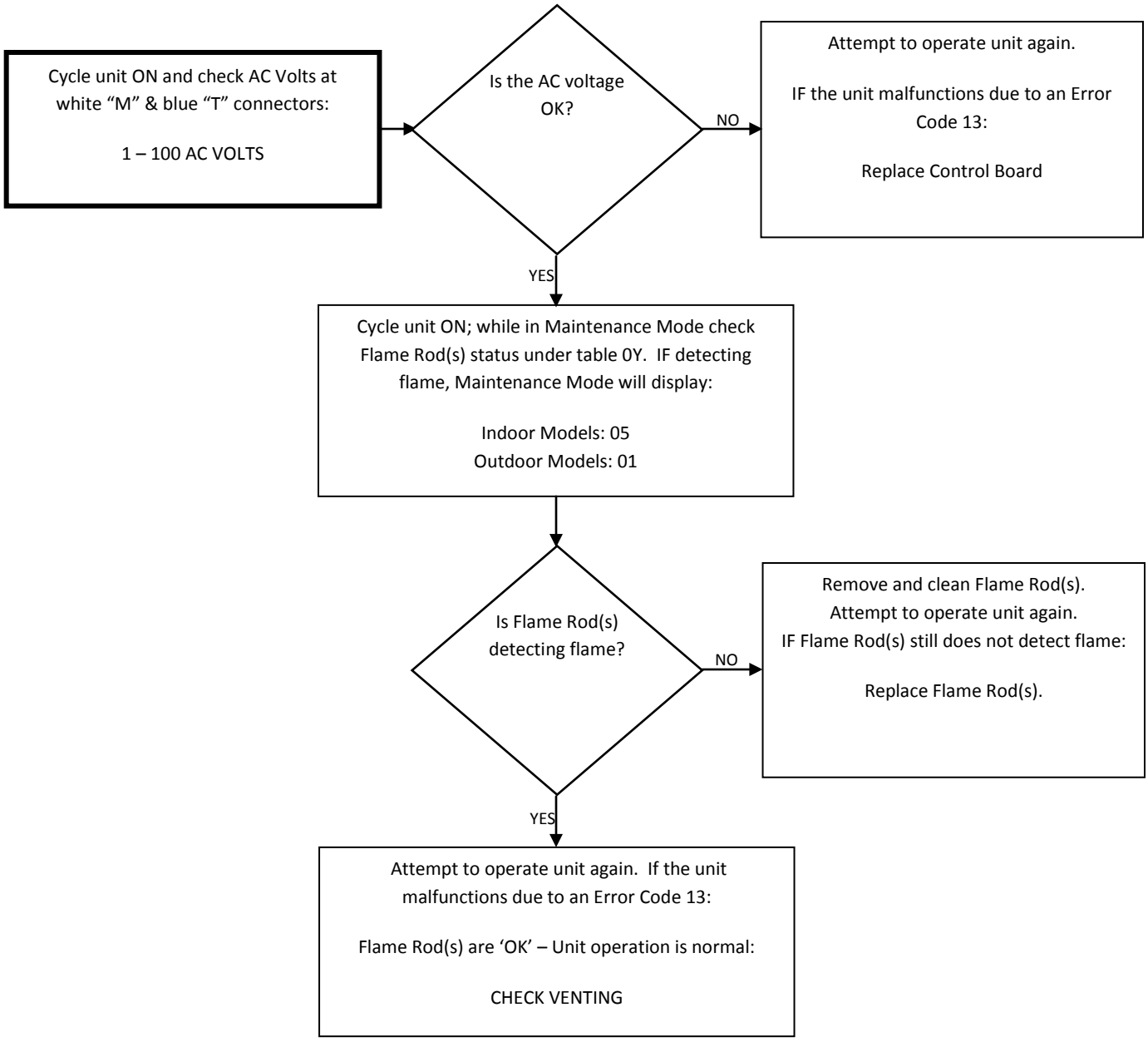


Locate sight glass. While unit is attempting to ignite, determine if flame is touching Flame Rod(s). IF NO, remove any foreign debris. IF foreign debris NOT present: CHECK GAS SUPPLY & VENTING.

4

On Remote Control; go to Maintenance Mode 0Y table. For Maintenance Mode instructions go to page 16. Continue to diagnostic chart on next page.

FLAME ROD(s) Diagnostic Chart


Cycle unit ON and check AC Volts at white "M" & blue "T" connectors:
1 – 100 AC VOLTS
Is the AC voltage OK?
NO
Attempt to operate unit again.
IF the unit malfunctions due to an Error Code 13:
Replace Control Board
YES
Cycle unit ON; while in Maintenance Mode check Flame Rod(s) status under table 0Y. IF detecting flame, Maintenance Mode will display:
Indoor Models: 05
Outdoor Models: 01
Is Flame Rod(s) detecting flame?
NO
Remove and clean Flame Rod(s).
Attempt to operate unit again.
IF Flame Rod(s) still does not detect flame:
Replace Flame Rod(s).
YES
Attempt to operate unit again. If the unit malfunctions due to an Error Code 13:
Flame Rod(s) are 'OK' – Unit operation is normal:
CHECK VENTING

14 – Error Code

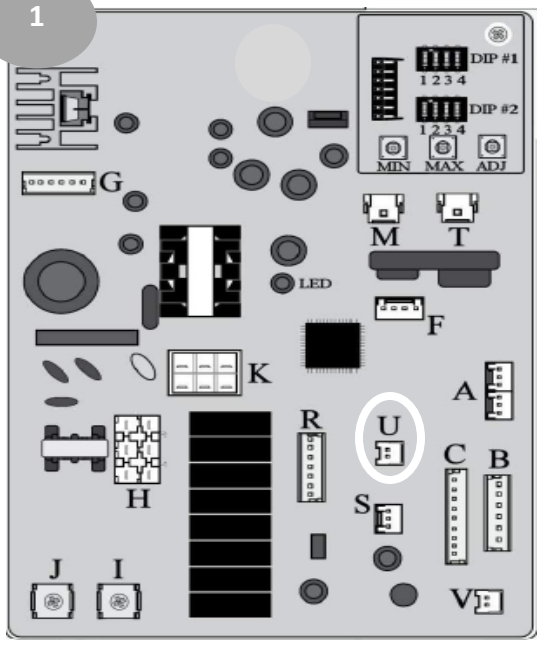
Explanation:
Mid & High Efficiency: Over Heat Limiter (OHL) malfunction.
High Efficiency ONLY:
Over heat condition in the venting has triggered the Over Temp Limit Switch

Diagnostic Checks:

- **Mid & High Efficiency:** OHL
- **High Efficiency ONLY:** Over Temp Limit Switch

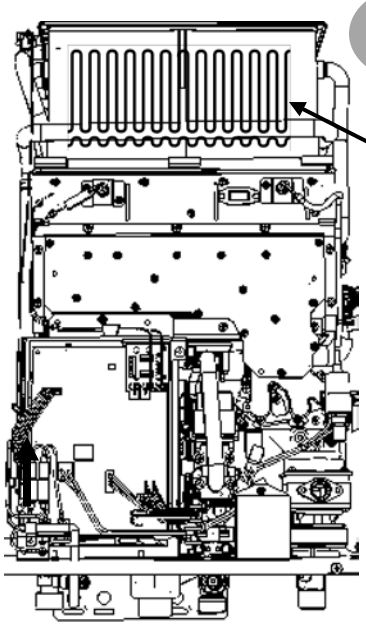
OHL DIAGNOSTICS:

1



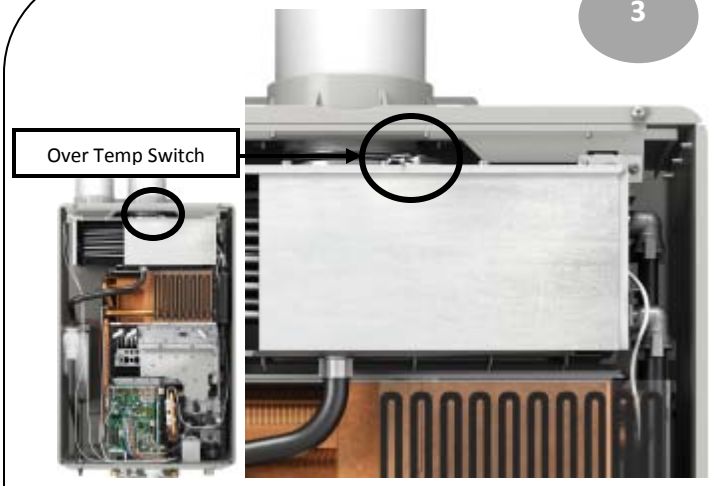
Turn power OFF. Remove and reinsert white connector "U" on Control Board (white Molex with 2 white wires). Attempt to operate unit again.

2



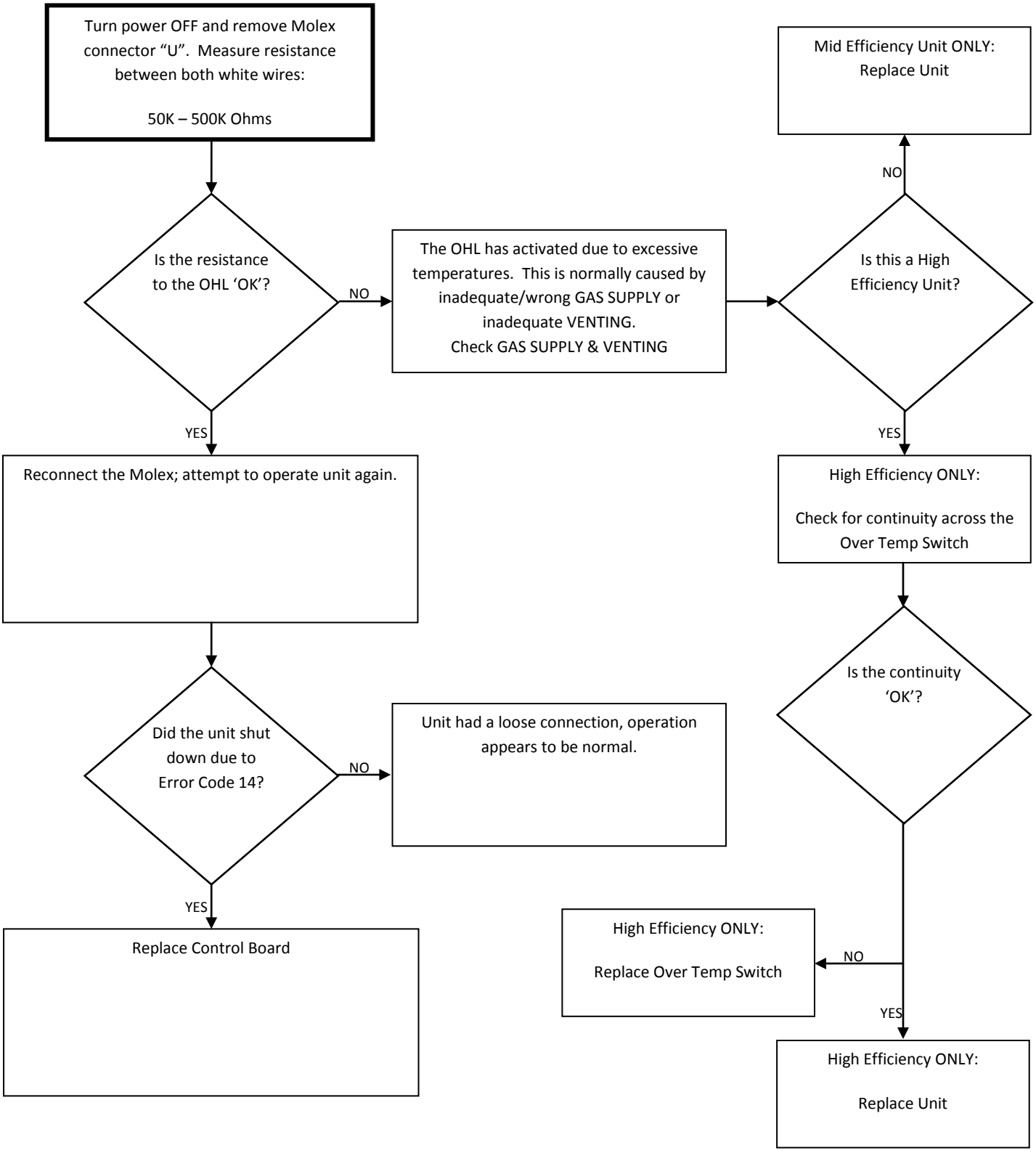
Mid Efficiency ONLY:
IF 14 Error Code does NOT display, unit had a loose connection. IF 14 Error Code IS displayed, continue to diagnostic chart on next page.

3



High Efficiency ONLY:
IF 14 Error Code does NOT display, unit had a loose connection.
IF 14 Error Code IS displayed, locate the over temp switch and continue to diagnostic chart on next page.

14 – Error Code Diagnostic Chart


Turn power OFF and remove Molex connector "U". Measure resistance between both white wires:
50K – 500K Ohms
Is the resistance to the OHL 'OK'?
NO
The OHL has activated due to excessive temperatures. This is normally caused by inadequate/wrong GAS SUPPLY or inadequate VENTING.
Check GAS SUPPLY & VENTING
Is this a High Efficiency Unit?
NO
Mid Efficiency Unit ONLY:
Replace Unit
YES
Reconnect the Molex; attempt to operate unit again.
High Efficiency ONLY:
Check for continuity across the Over Temp Switch
Is the continuity 'OK'?
Did the unit shut down due to Error Code 14?
NO
Unit had a loose connection, operation appears to be normal.
YES
Replace Control Board
High Efficiency ONLY:
Replace Over Temp Switch
NO
YES
High Efficiency ONLY:
Replace Unit

NOTES:

15 – Error Code

Explanation: The hot water temperature and/or heat exchanger temperature reached 207 degrees F for more than 15 seconds.
IMPORTANT: Inadequate GAS SUPPLY and/or VENTING will create hot spots in the heat exchanger.

Diagnostic Checks:

- GAS SUPPLY & VENTING
- Sediment Build-Up in Heat Exchanger
- Heat Exchanger Temperature Sensor

GAS SUPPLY & VENTING
****REFER TO USE & CARE MANUAL****

Make sure you have sufficient fuel for the unit to operate properly.

1. Gas Type (LP or Natural Gas)
2. Gas Pressure
3. Gas Pipe Size
4. Gas Flex Line Not To Exceed 36" In Length, has the proper ID (Inside Diameter), and correct BTU rating
5. Gas Regulator
6. Gas Shut Off Valves
7. Air In Gas Line

Visually inspect venting for possible blockage and/or recirculation of exhaust.

1. Approved Venting Materials
2. Approved Vent Terminations
3. Vent Lengths
4. Location Of Vent Termination (Recirculation of exhaust)
5. Blocked Venting
6. Venting Not Sealed Properly

***SEDIMENT BUILD-UP DIAGNOSTICS*:**

Go to Error Code 1L for flushing instructions

***HEAT EXCHANGER THERMISTOR DIAGNOSTICS*:**

Go to Error Code 32 for Heat Exchanger Thermistor diagnostic instructions.

16 – Error Code

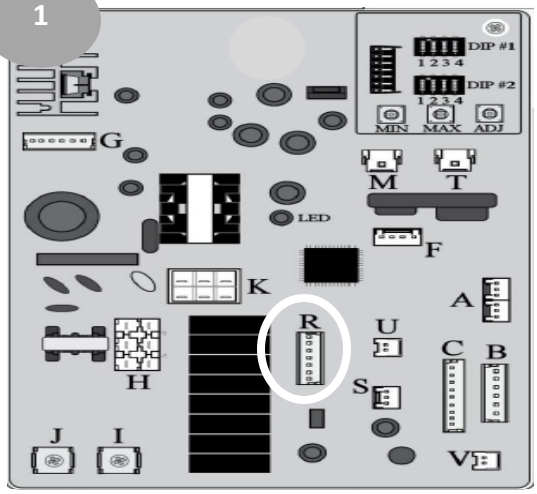
Explanation: Outlet water temperature is too hot. The water temperature is above the set point on Remote Control.
Check the Outlet Thermistor FIRST.

Diagnostic Checks:

1. Outlet Thermistor
2. Water Bypass Valve

OUTLET THERMISTOR DIAGNOSTICS:

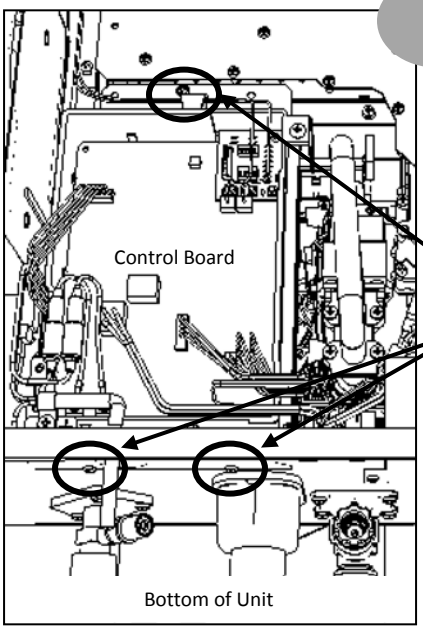
1



Turn power OFF. Remove connector "R" on Control Board. Measure resistance between Black #3 & red #4 wires: 7K – 23K Ohms. IF OK, attempt to operate unit again. IF 16 Error Code does NOT display, unit had a loose connection.

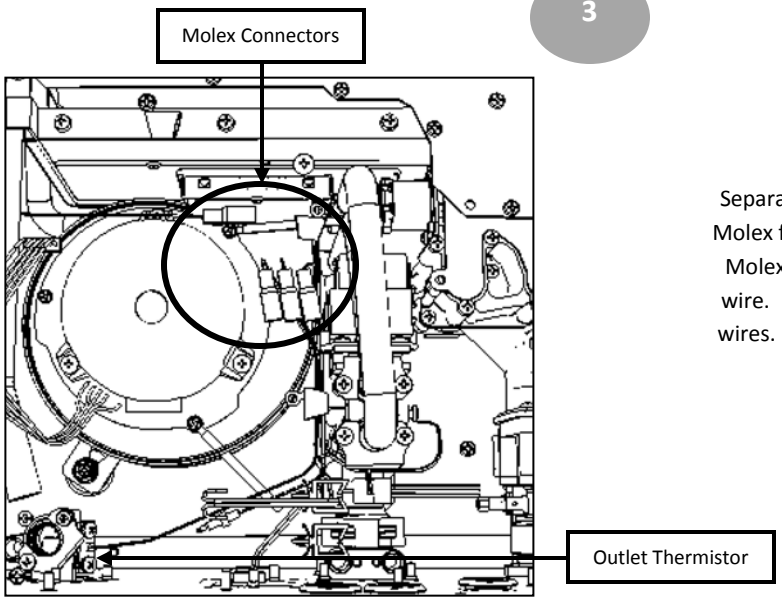
IF resistance tested OK and 16 Error Code IS displayed, go to Error Code 66 for Water Bypass Valve diagnostics. IF resistance NOT OK, go to step 2.

2



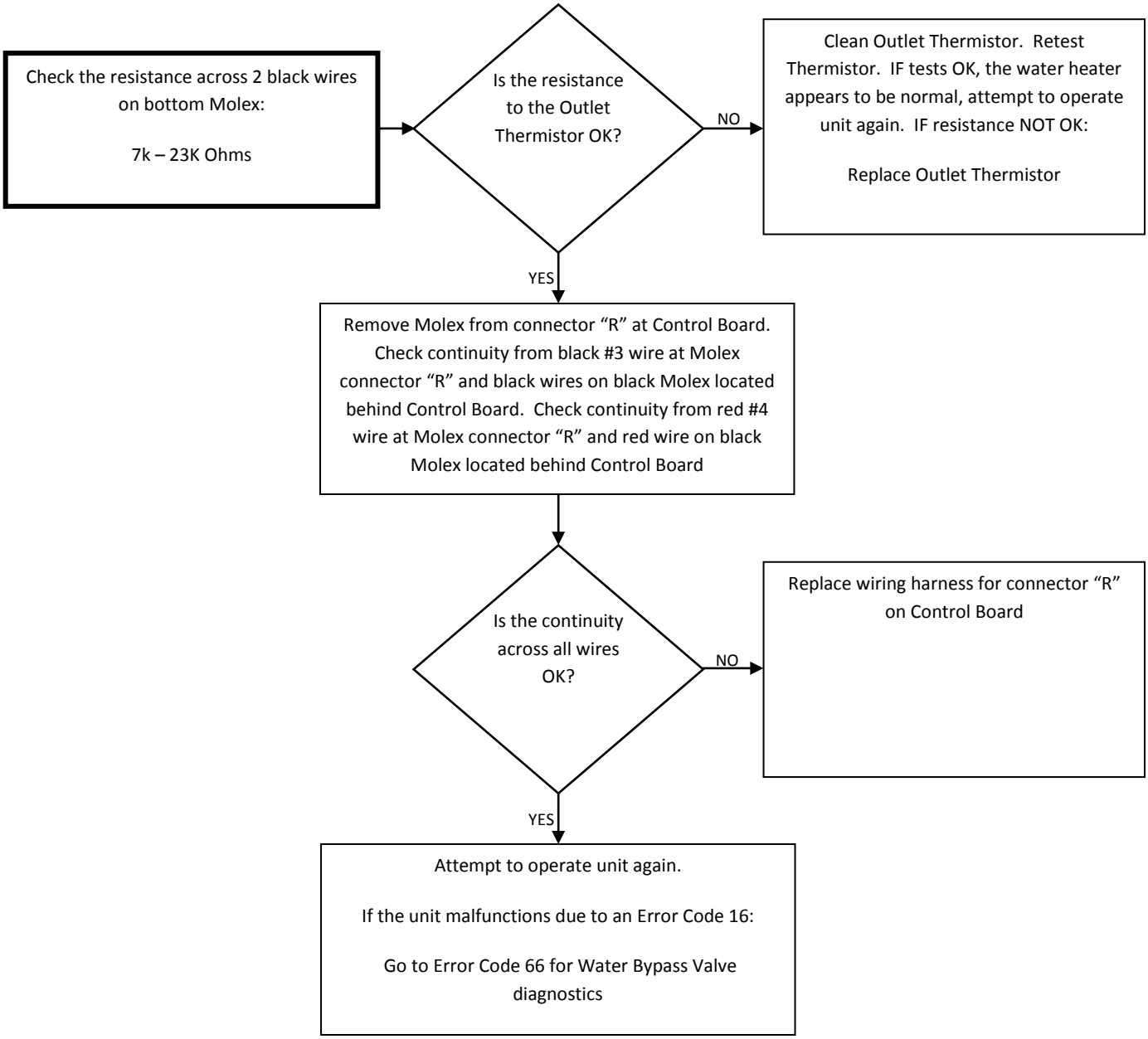
Turn power OFF. Remove 3 screws for Control Board mounting bracket. Remove connectors "M", "T" & "G". Pull control board out of way to access BLACK Molex for Outlet Thermistor located near the Blower Motor.

3



Separate top and bottom of BLACK Molex for Outlet Thermistor. Top of Molex has 2 black wires and 1 red wire. Bottom of Molex has 2 black wires. Continue to diagnostic chart on next page.

16 – Error Code Diagnostic Chart


Check the resistance across 2 black wires on bottom Molex:
7k – 23K Ohms
Is the resistance to the Outlet Thermistor OK?
NO
Clean Outlet Thermistor. Retest Thermistor. IF tests OK, the water heater appears to be normal, attempt to operate unit again. IF resistance NOT OK:
Replace Outlet Thermistor
YES
Remove Molex from connector "R" at Control Board. Check continuity from black #3 wire at Molex connector "R" and black wires on black Molex located behind Control Board. Check continuity from red #4 wire at Molex connector "R" and red wire on black Molex located behind Control Board
Is the continuity across all wires OK?
NO
Replace wiring harness for connector "R" on Control Board
YES
Attempt to operate unit again.
If the unit malfunctions due to an Error Code 16:
Go to Error Code 66 for Water Bypass Valve diagnostics

24 – Error Code

Explanation: Remote Control buttons were depressed for more than 20 seconds. IF you were manually holding down any Remote Control buttons for more than 20 seconds, release the buttons and NO Error Code will be displayed. Unit will operate normally. IF error code 24 is still displayed after releasing Remote Control buttons, continue to Remote Control diagnostics.

Diagnostic Checks:

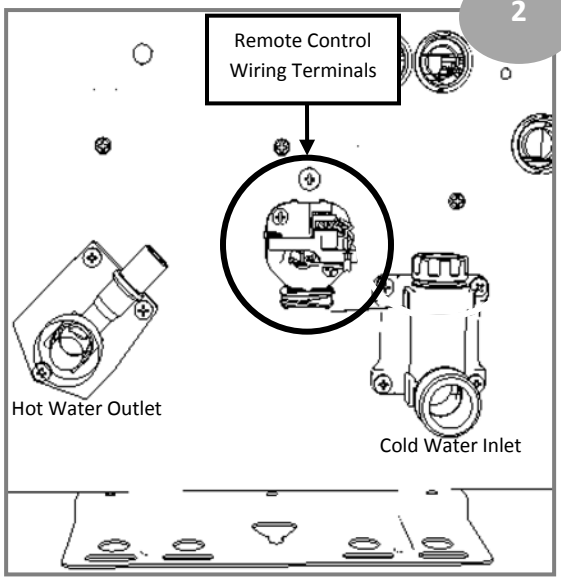
- Remote Control

REMOTE CONTROL DIAGNOSTICS:

1

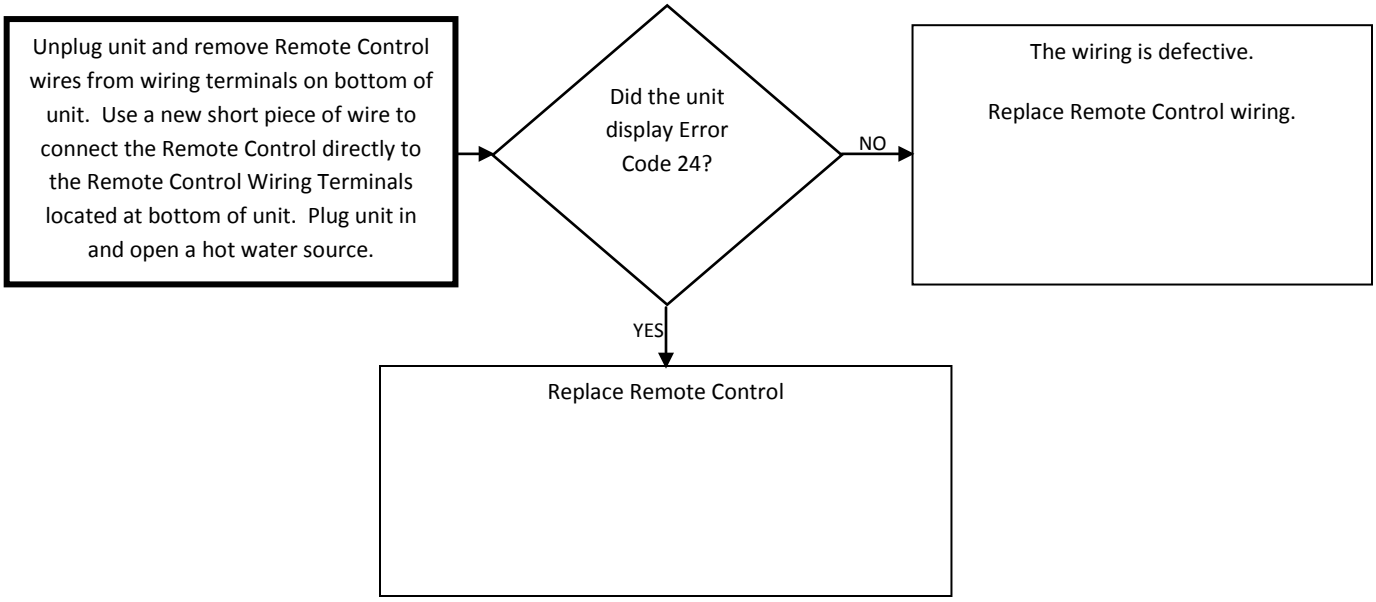
Visually inspect Remote Control wiring for damaged or loose terminals.

2



Turn power OFF. Remove and reconnect Remote Control wiring terminals at bottom of unit. Attempt to operate unit again. IF 24 Error Code does NOT display, unit had a loose connection.
IF 24 Error Code IS displayed, continue to diagnostic chart on next page.

24 – Error Code Diagnostic Chart


Unplug unit and remove Remote Control wires from wiring terminals on bottom of unit. Use a new short piece of wire to connect the Remote Control directly to the Remote Control Wiring Terminals located at bottom of unit. Plug unit in and open a hot water source.
Did the unit display Error Code 24?
NO
The wiring is defective.
Replace Remote Control wiring.
YES
Replace Remote Control

NOTES:

29 – Error Code

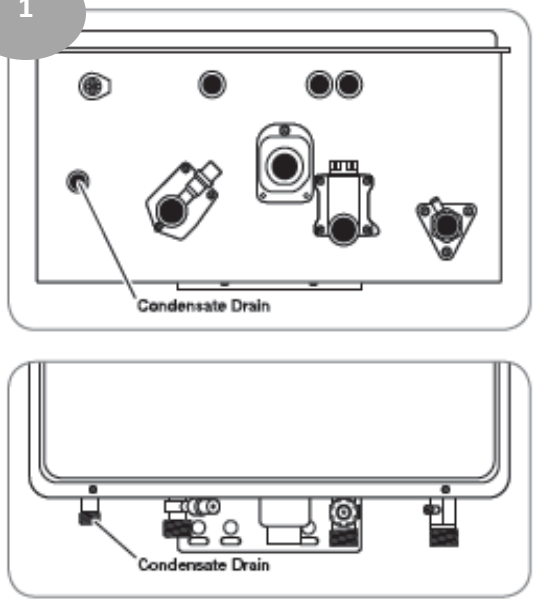
Explanation:
High Efficiency Condensing Units ONLY:
Condensate Drain is NOT draining.

Diagnostic Checks:

- Plug not removed from condensate drain
- Pinch in condensate drain line
- Blockage in condensate drain line
- Drain line has unnecessary "P" trap

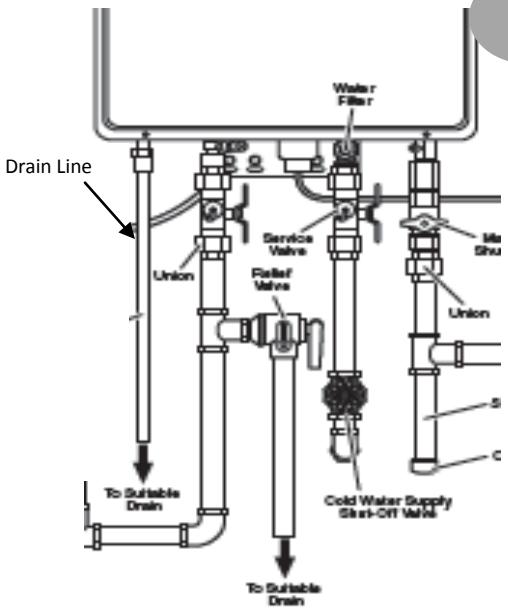
CONDENSATE DRAIN DIAGNOSTICS:

1



Ensure you removed the condensate protection plug located at bottom of unit.

2



Check your condensate drain line for internal or external blockage. Make sure drain line is NOT pinched.

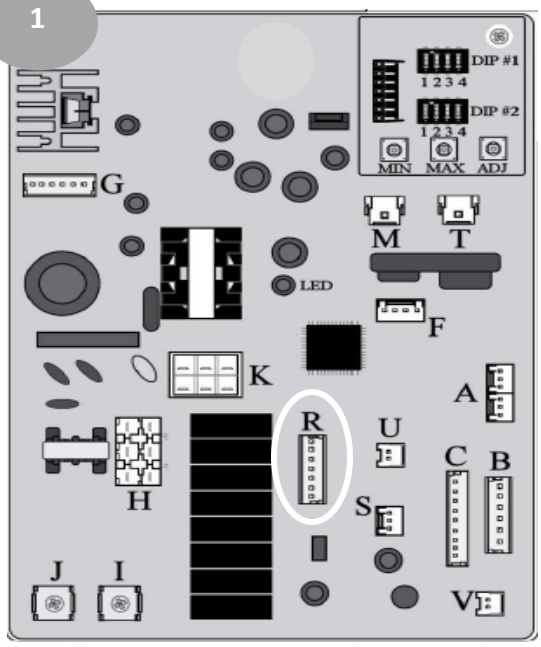
31 – Error Code

Explanation:
Inlet Thermistor malfunction

Diagnostic Checks:
- *Inlet Thermistor*

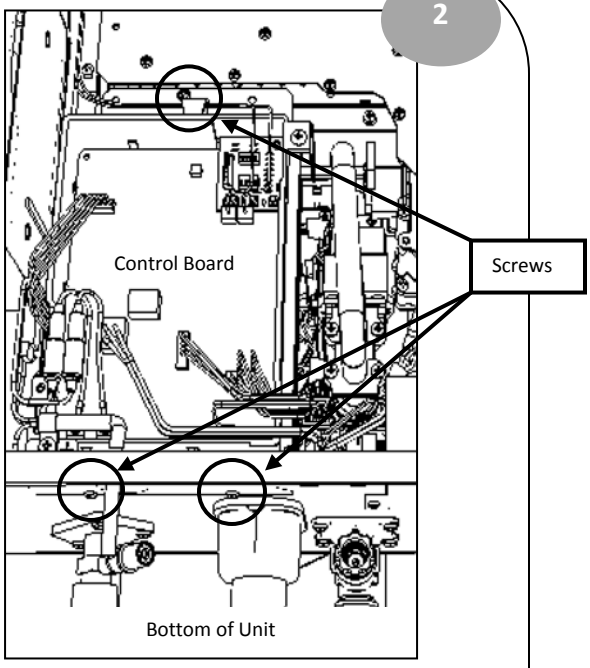
INLET THERMISTOR DIAGNOSTICS:

1



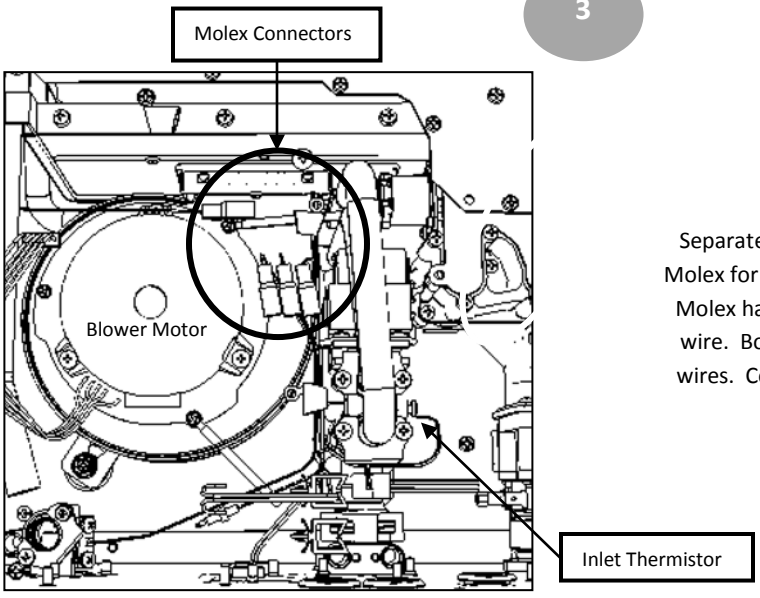
Turn power OFF. Remove connector "R" on Control Board. Measure resistance between Black #3 & white #6 wires: 7K – 23K Ohms. IF OK, attempt to operate unit again. IF 31 Error Code does NOT display, you had a loose connection.

2



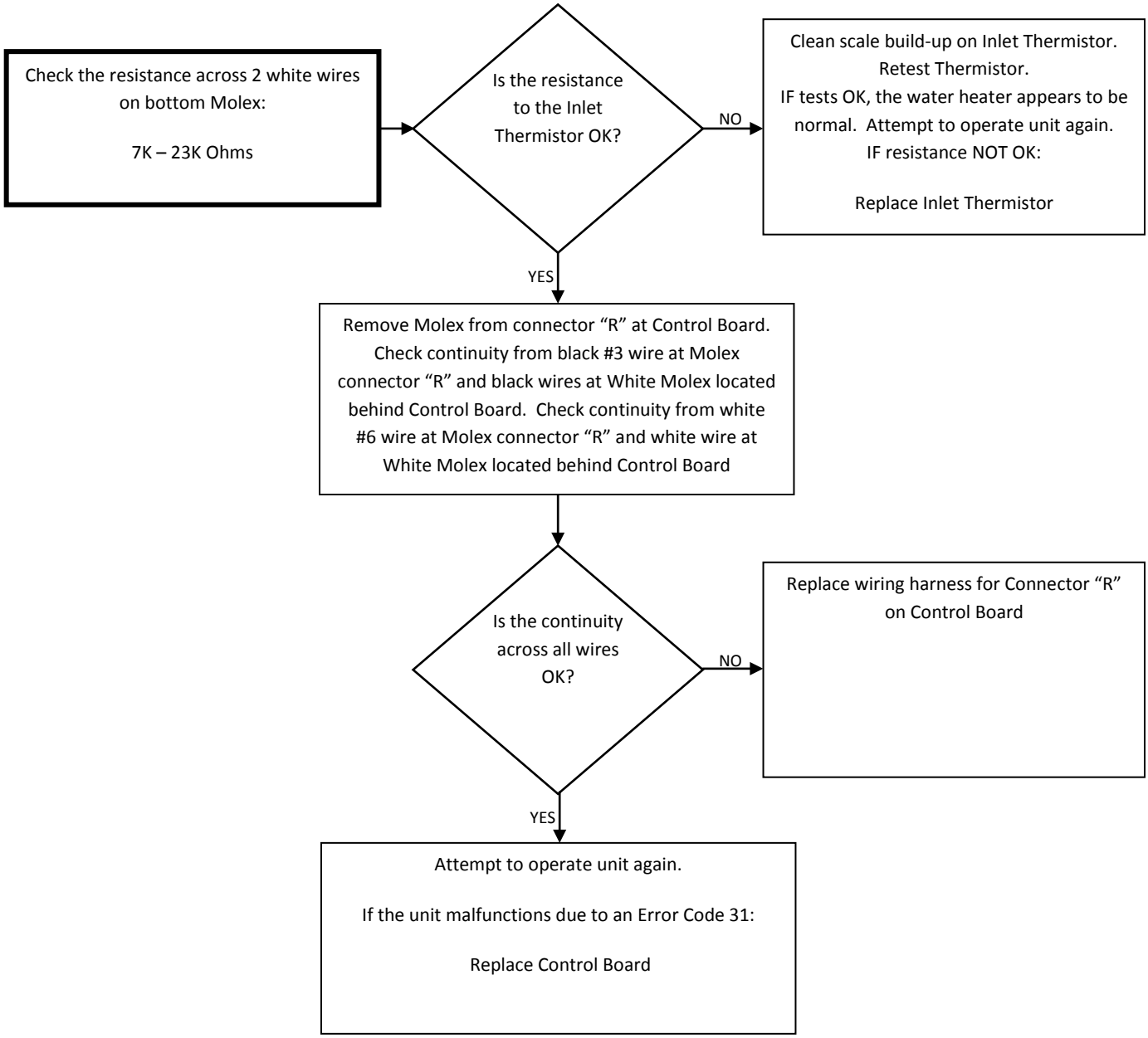
Turn power OFF. Remove 3 screws for Control Board mounting bracket. Remove connectors "M", "T" & "G". Pull Control Board out of way to access WHITE Molex for Inlet Thermistor located near the Blower Motor.

3



Separate top and bottom of WHITE Molex for the Inlet Thermistor. Top of Molex has 2 black wires and 1 white wire. Bottom of Molex has 2 white wires. Continue to Diagnostic Chart on next page.

31 – Error Code Diagnostic Chart


Check the resistance across 2 white wires on bottom Molex:
7K – 23K Ohms
Is the resistance to the Inlet Thermistor OK?
NO
Clean scale build-up on Inlet Thermistor. Retest Thermistor.
IF tests OK, the water heater appears to be normal. Attempt to operate unit again.
IF resistance NOT OK:
Replace Inlet Thermistor
YES
Remove Molex from connector "R" at Control Board. Check continuity from black #3 wire at Molex connector "R" and black wires at White Molex located behind Control Board. Check continuity from white #6 wire at Molex connector "R" and white wire at White Molex located behind Control Board
Is the continuity across all wires OK?
NO
Replace wiring harness for Connector "R" on Control Board
YES
Attempt to operate unit again.
If the unit malfunctions due to an Error Code 31:
Replace Control Board

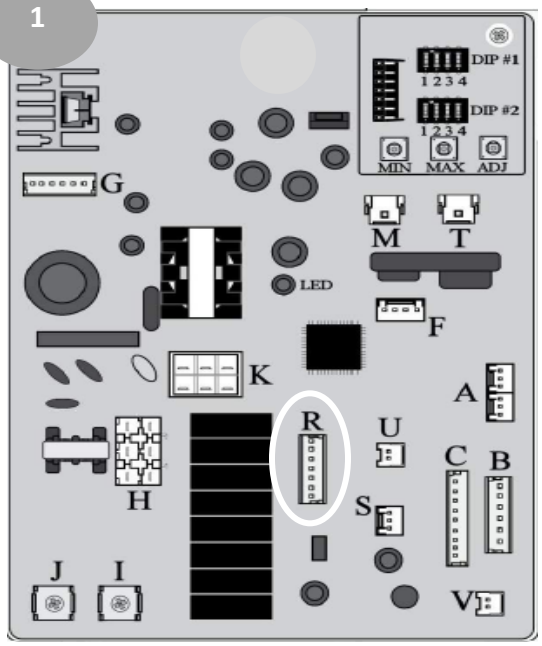
32 – Error Code

Explanation:
Heat Exchanger Thermistor malfunction

Diagnostic Checks:
- *Heat Exchanger Thermistor*

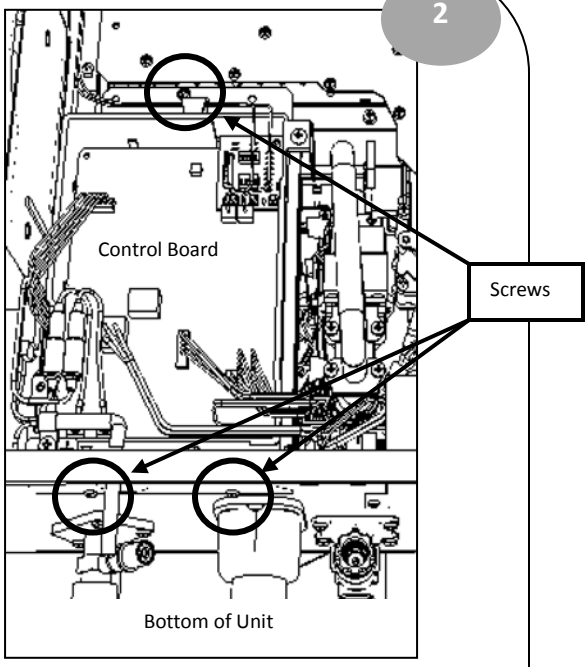
HEAT EXHCANGER THERMISTOR DIAGNOSTICS:

1



Turn power OFF. Remove connector "R" on Control Board. Measure resistance between Black #3 & YELLOW* #5 wires: 7K – 23K Ohms. IF OK, attempt to operate unit again. IF 32 Error Code does NOT display, unit had a loose connection.

2

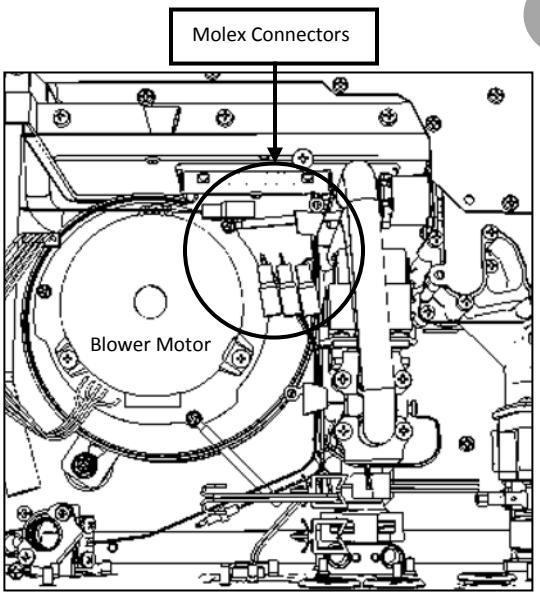


Turn power OFF. Remove 3 screws for Control Board mounting bracket. Remove connectors "M", "T" & "G". Pull Control Board out of way to access YELLOW* Molex for Heat Exchanger Thermistor located near the Blower Motor.

High Efficiency (Condensing) Units ONLY:
GREEN wire & GREEN Molex

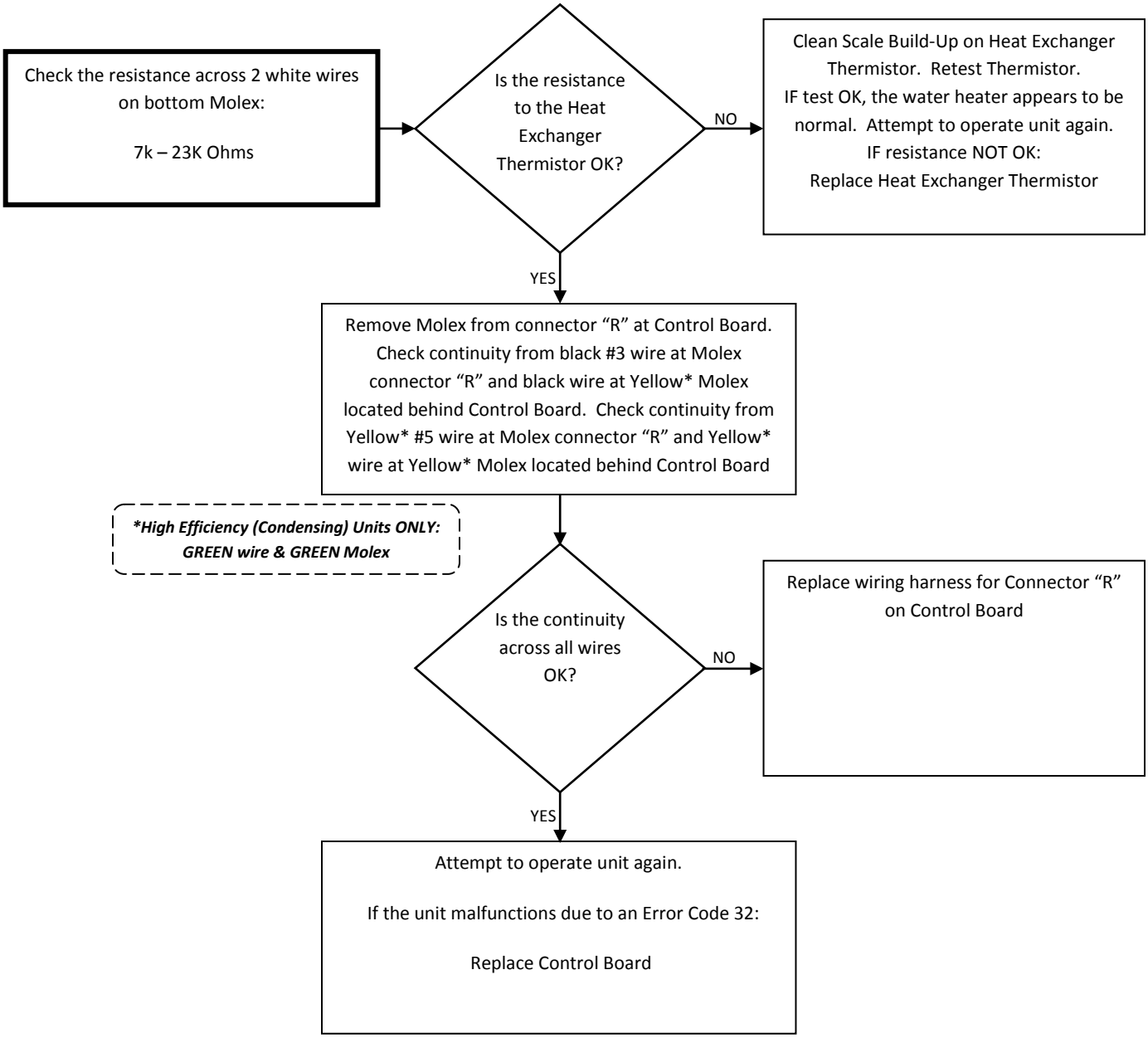
3

High Efficiency (Condensing) Units ONLY:
GREEN wire & GREEN Molex



Separate top and bottom of YELLOW* Molex for Heat Exchanger Thermistor. Top of Molex has 2 black wires and 1 YELLOW* wire. Bottom of Molex has 2 white wires. Continue to Diagnostic Chart on next page.

32 – Error Code Diagnostic Chart


Check the resistance across 2 white wires on bottom Molex:
7k – 23K Ohms
Is the resistance to the Heat Exchanger Thermistor OK?
NO
Clean Scale Build-Up on Heat Exchanger Thermistor. Retest Thermistor.
IF test OK, the water heater appears to be normal. Attempt to operate unit again.
IF resistance NOT OK:
Replace Heat Exchanger Thermistor
YES
Remove Molex from connector "R" at Control Board. Check continuity from black #3 wire at Molex connector "R" and black wire at Yellow* Molex located behind Control Board. Check continuity from Yellow* #5 wire at Molex connector "R" and Yellow* wire at Yellow* Molex located behind Control Board
*High Efficiency (Condensing) Units ONLY: GREEN wire & GREEN Molex
Is the continuity across all wires OK?
NO
Replace wiring harness for Connector "R" on Control Board
YES
Attempt to operate unit again.
If the unit malfunctions due to an Error Code 32:
Replace Control Board

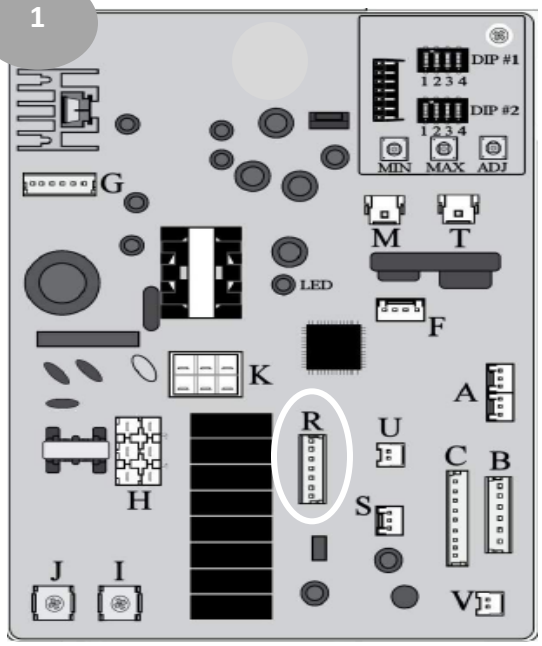
33 – Error Code

Explanation:
Outlet Thermistor malfunction

Diagnostic Checks:
- *Outlet Thermistor*

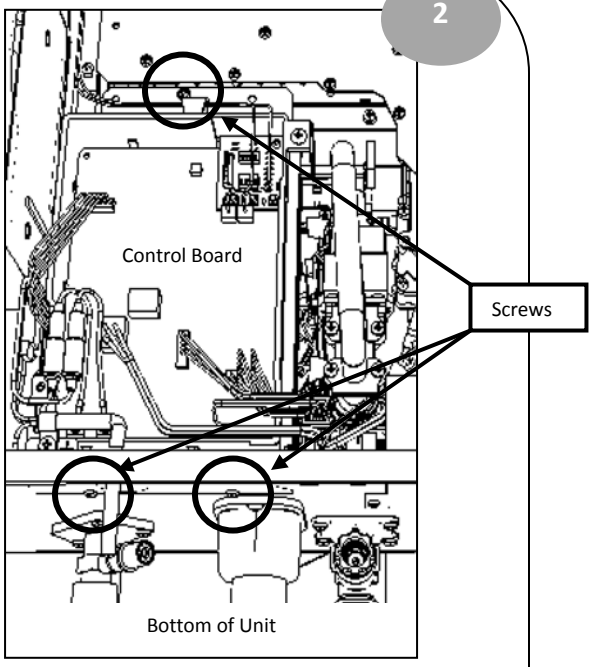
OUTLET THERMISTOR DIAGNOSTICS:

1



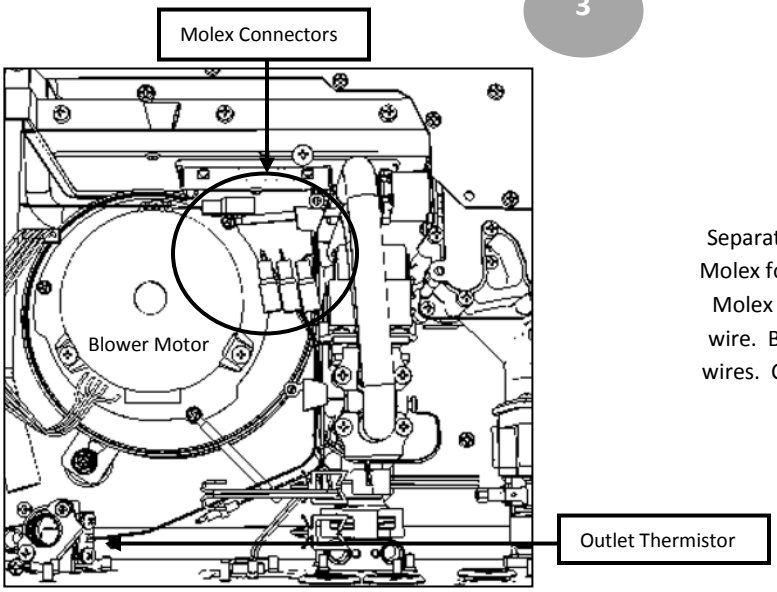
Turn power OFF. Remove connector "R" on Control Board. Measure resistance between Black #3 & Red #4 wires: 7K – 23K Ohms. IF OK, attempt to operate unit again. IF 33 Error Code does NOT display, unit had a loose connection.

2



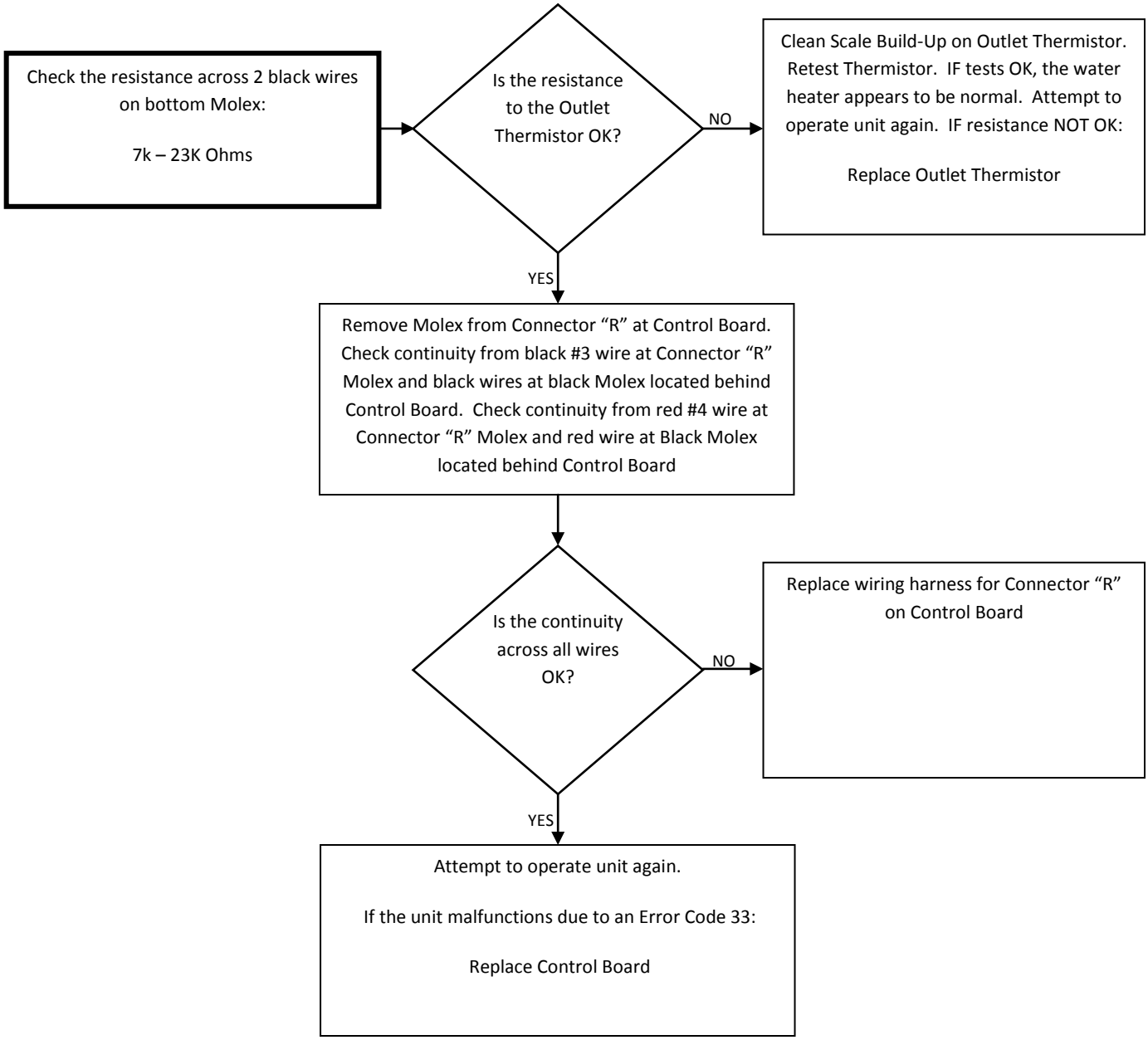
Turn power OFF. Remove 3 screws for Control Board mounting bracket. Remove connectors "M", "T" & "G". Pull Control Board out of way to access BLACK Molex for Outlet Thermistor located near the Blower Motor.

3



Separate top and bottom of BLACK Molex for Outlet Thermistor. Top of Molex has 2 black wires and 1 red wire. Bottom of Molex has 2 black wires. Continue to Diagnostic Chart on next page.

33 – Error Code Diagnostic Chart


Check the resistance across 2 black wires on bottom Molex:
7k – 23K Ohms
Is the resistance to the Outlet Thermistor OK?
NO
Clean Scale Build-Up on Outlet Thermistor. Retest Thermistor. IF tests OK, the water heater appears to be normal. Attempt to operate unit again. IF resistance NOT OK:
Replace Outlet Thermistor
YES
Remove Molex from Connector "R" at Control Board. Check continuity from black #3 wire at Connector "R" Molex and black wires at black Molex located behind Control Board. Check continuity from red #4 wire at Connector "R" Molex and red wire at Black Molex located behind Control Board
Is the continuity across all wires OK?
NO
Replace wiring harness for Connector "R" on Control Board
YES
Attempt to operate unit again.
If the unit malfunctions due to an Error Code 33:
Replace Control Board

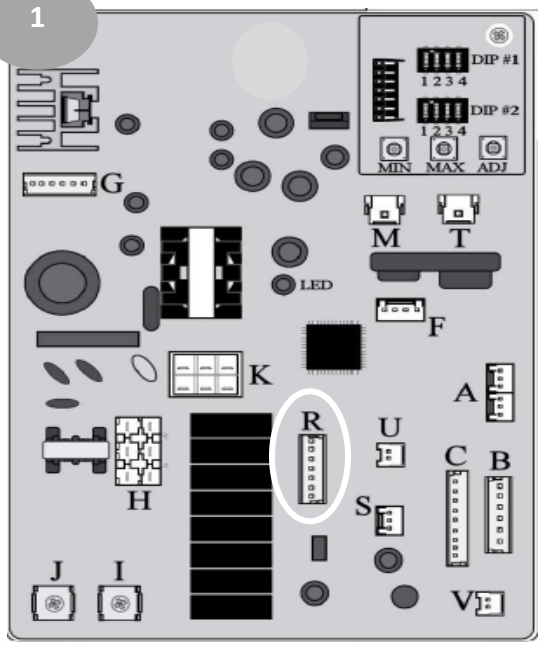
34 – Error Code

Explanation:
Ambient Thermistor malfunction

Diagnostic Checks:
- *Ambient Thermistor*

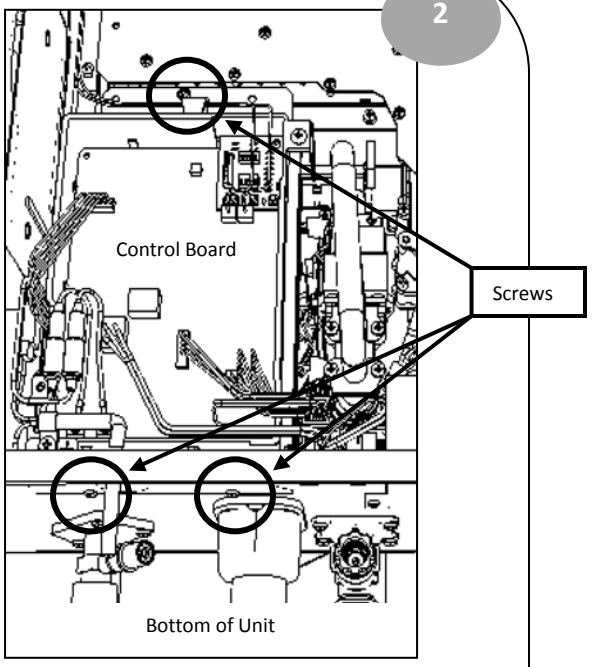
AMBIENT THERMISTOR DIAGNOSTICS:

1



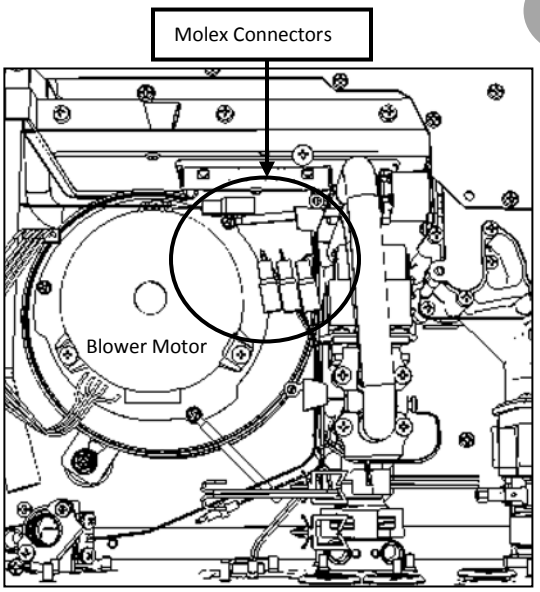
Turn power OFF. Remove connector "R" on Control Board. Measure resistance between Black #3 & Blue #7 wires: 'Refer to Data Table for resistance value'. IF OK, attempt to operate unit again. IF 34 Error Code does NOT display, unit had a loose connection.

2



Turn power OFF. Remove 3 screws for Control Board mounting bracket. Remove connectors "M", "T" & "G". Pull Control Board out of way to access BLUE Molex for Ambient Thermistor located near the Blower Motor.

3



Separate top and bottom of BLUE Molex for Ambient Thermistor. Top of Molex has 2 black wires and 1 blue wire. Bottom of Molex has 2 black wires. Continue to Diagnostic Chart on next page.

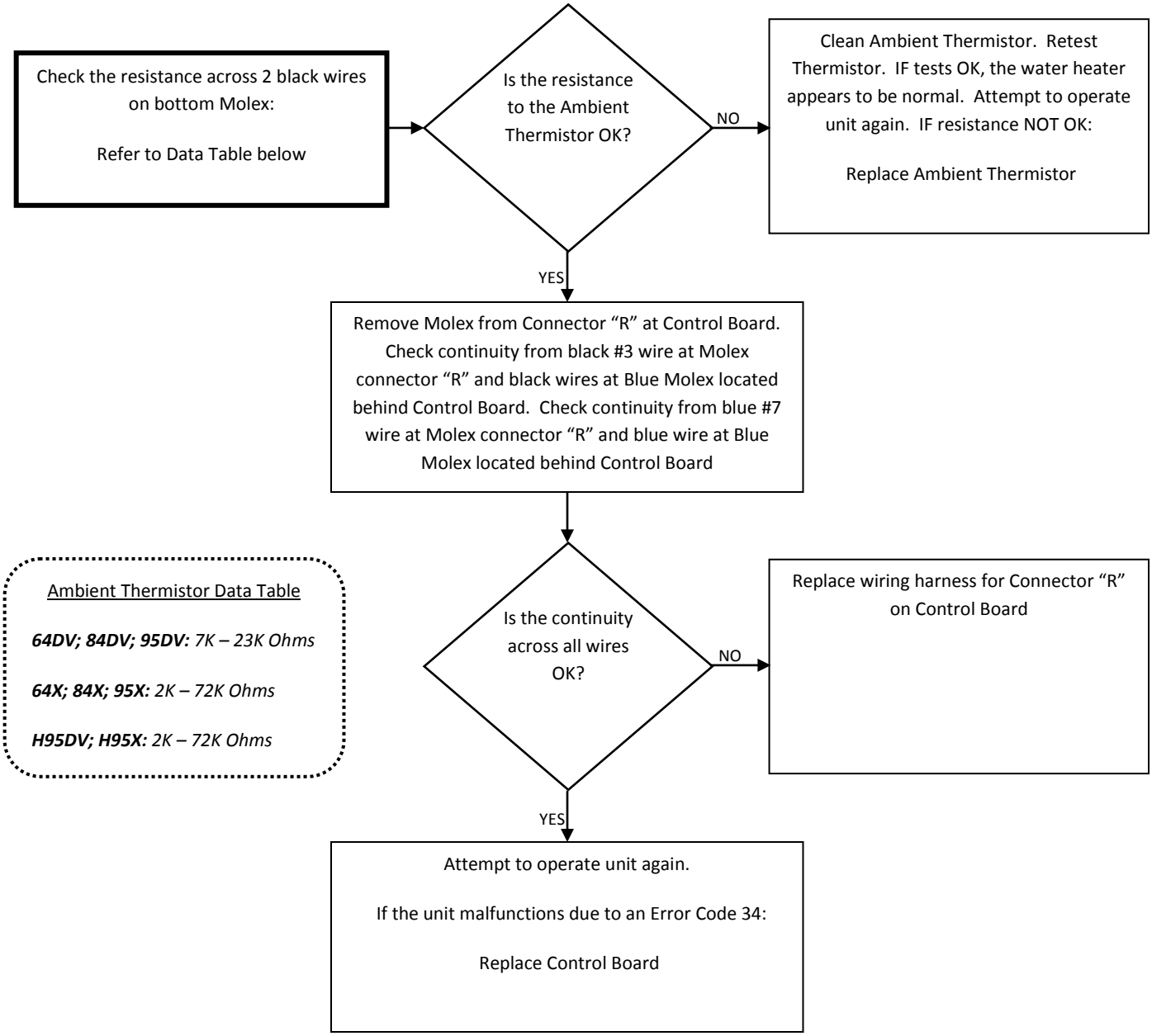
Ambient Thermistor Data Table

64DV; 84DV; 95DV: *7K – 23K Ohms*

64X; 84X; 95X: *2K – 72K Ohms*

H95DV; H95X: *2K – 72K Ohms*

34 – Error Code Diagnostic Chart


Check the resistance across 2 black wires on bottom Molex:
Refer to Data Table below
Is the resistance to the Ambient Thermistor OK?
NO
Clean Ambient Thermistor. Retest Thermistor. IF tests OK, the water heater appears to be normal. Attempt to operate unit again. IF resistance NOT OK:
Replace Ambient Thermistor
YES
Remove Molex from Connector "R" at Control Board. Check continuity from black #3 wire at Molex connector "R" and black wires at Blue Molex located behind Control Board. Check continuity from blue #7 wire at Molex connector "R" and blue wire at Blue Molex located behind Control Board
Ambient Thermistor Data Table
64DV; 84DV; 95DV: 7K – 23K Ohms
64X; 84X; 95X: 2K – 72K Ohms
H95DV; H95X: 2K – 72K Ohms
Is the continuity across all wires OK?
NO
Replace wiring harness for Connector "R" on Control Board
YES
Attempt to operate unit again.
If the unit malfunctions due to an Error Code 34:
Replace Control Board

35 – Error Code

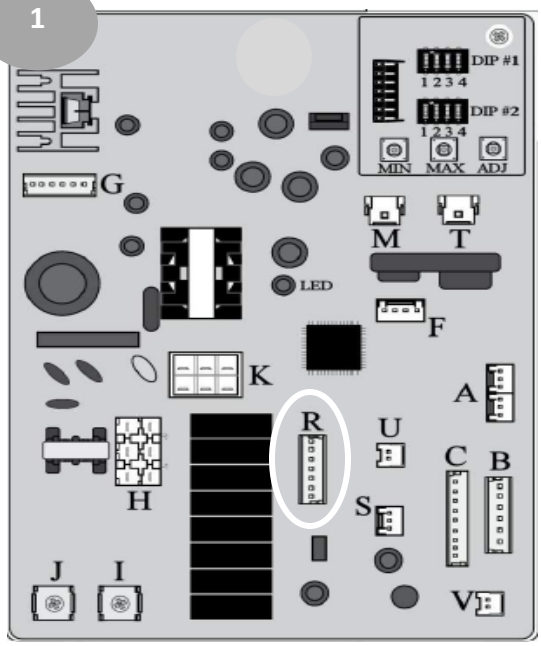
Explanation: Improper Thermistor connection. Unit has four Thermistors; one or more possibly has a poor connection or not connected in proper location.

Diagnostic Checks:

- *Inlet, Heat Exchanger, Outlet, and Ambient Thermistors.*

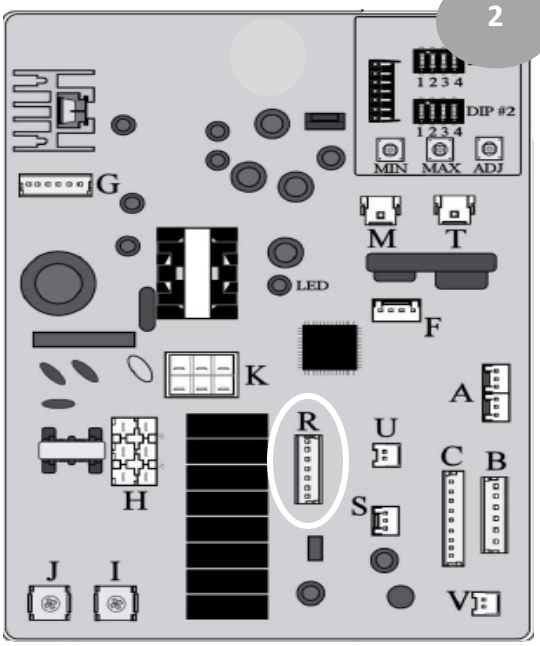
THERMISTORS DIAGNOSTICS:

1



Turn power OFF. Remove and reinsert connector "R" on Control Board. Attempt to operate unit again. IF 35 Error Code does NOT display, unit had a loose connection.

2



Turn power OFF. Remove connector "R" on Control Board. Measure the resistance for all temperature sensors (step 3). IF temperature sensor FAILS the resistance check, go to the appropriate Error Code for diagnostics. IF sensors test 'OK' continue to next page.

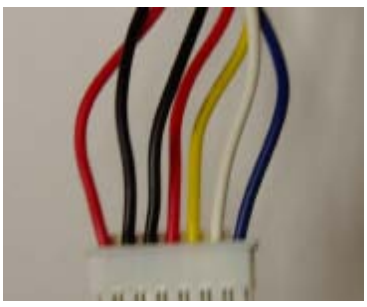
3

Black #3 & Blue #7 Wires: Ambient Thermistor

64DV; 84DV; 95DV: 7K – 23K Ohms

64X; 84X; 95X: 2K – 72K Ohms

H95DV; H95X: 2K – 72K Ohms



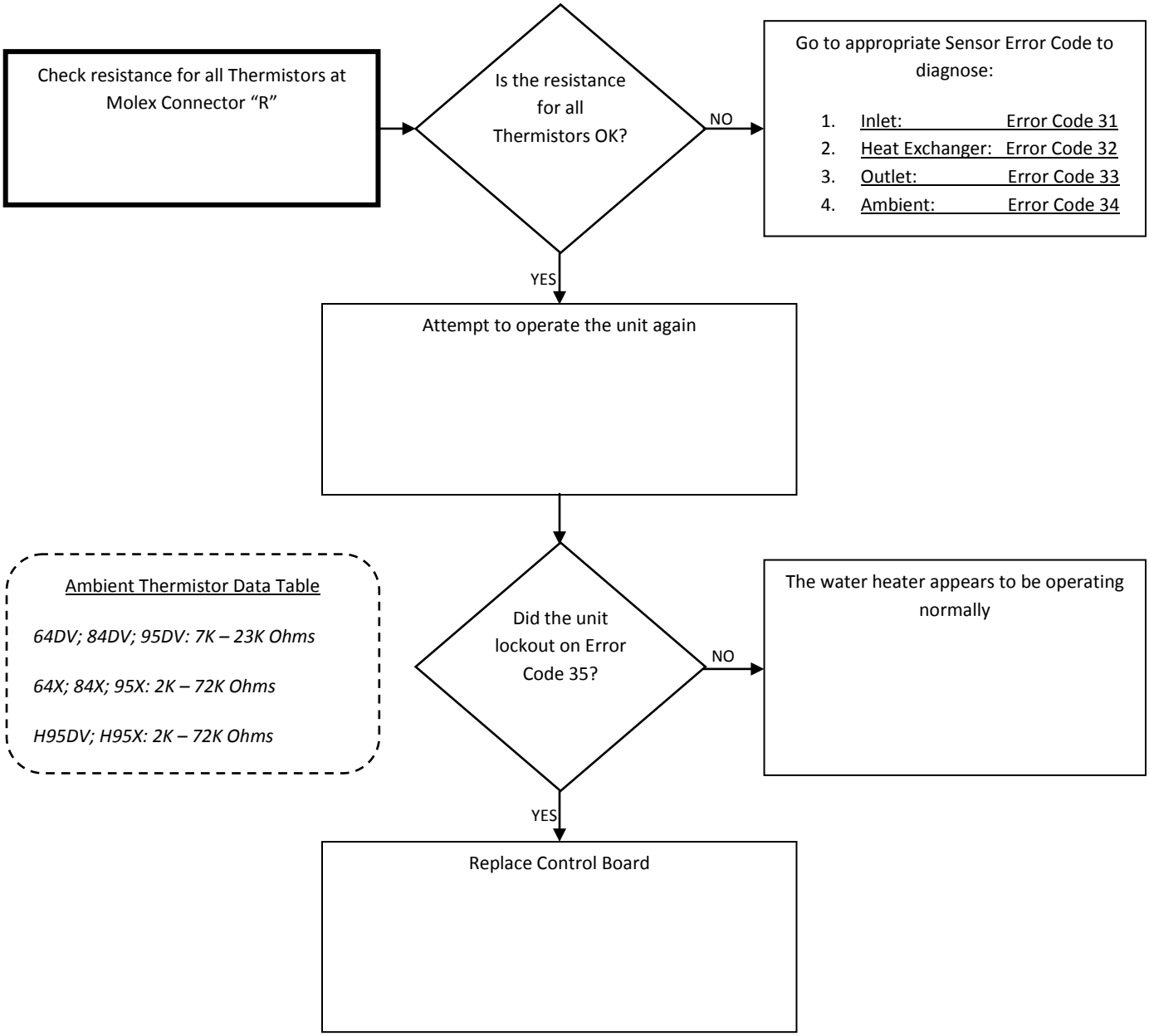
Black #3 & White #6 Wires: Inlet Thermistor
7K – 23K Ohms. Error Code 31

Black #3 & Yellow #5 Wires: Heat Exchanger Thermistor
7K – 23K Ohms. Error Code 32

Black #3 & Red #4 Wires: Outlet Thermistor
7K – 23K Ohms. Error Code 33

Black #3 & Blue #7 Wires: Ambient Thermistor
Refer to Data Table. Error Code 34

35 – Error Code Diagnostic Chart


Check resistance for all Thermistors at Molex Connector "R"
Is the resistance for all Thermistors OK?
NO
Go to appropriate Sensor Error Code to diagnose:
1. Inlet: Error Code 31
2. Heat Exchanger: Error Code 32
3. Outlet: Error Code 33
4. Ambient: Error Code 34
YES
Attempt to operate the unit again
Ambient Thermistor Data Table
64DV; 84DV; 95DV: 7K – 23K Ohms
64X; 84X; 95X: 2K – 72K Ohms
H95DV; H95X: 2K – 72K Ohms
Did the unit lockout on Error Code 35?
NO
The water heater appears to be operating normally
YES
Replace Control Board

51 – Error Code

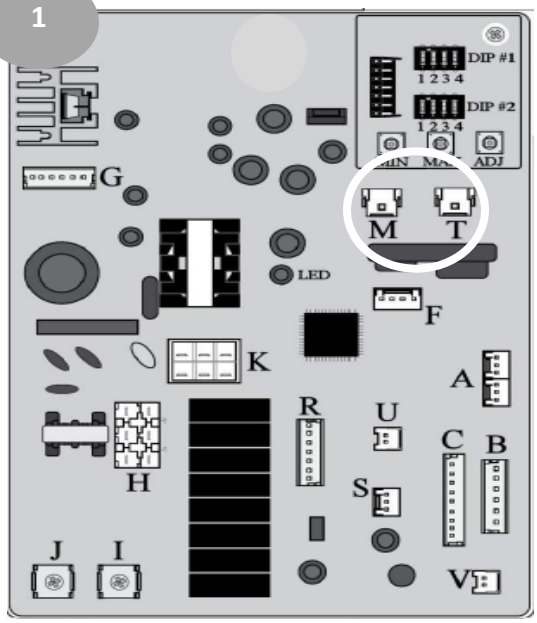
Explanation: Gas Control Valve malfunction. The unit detects the presence of flame when the demand for hot water is terminated and burner is OFF. This error code will only occur at time of shut down.

Diagnostic Checks:

- *Flame Rods(s)*
- *Gas Control Valve*

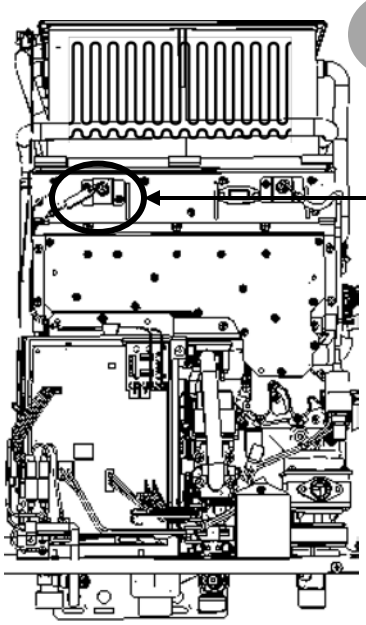
FLAME RODS & GAS VALVE DIAGNOSTICS:

1



Turn power OFF. Remove and reinsert white connector “M” and blue connector “T” on Control Board.

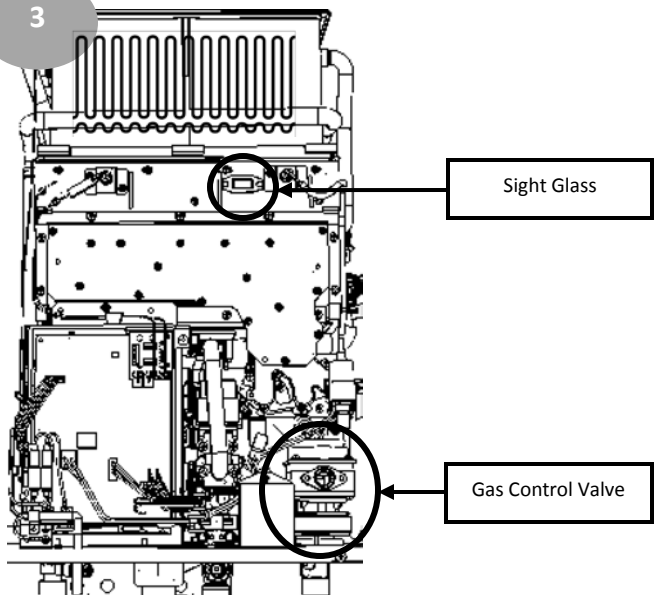
2



Remove and reinsert terminals on Fame Rod(s)*. Attempt to operate unit again. IF 51 Error Code does NOT display, unit had a loose connection.

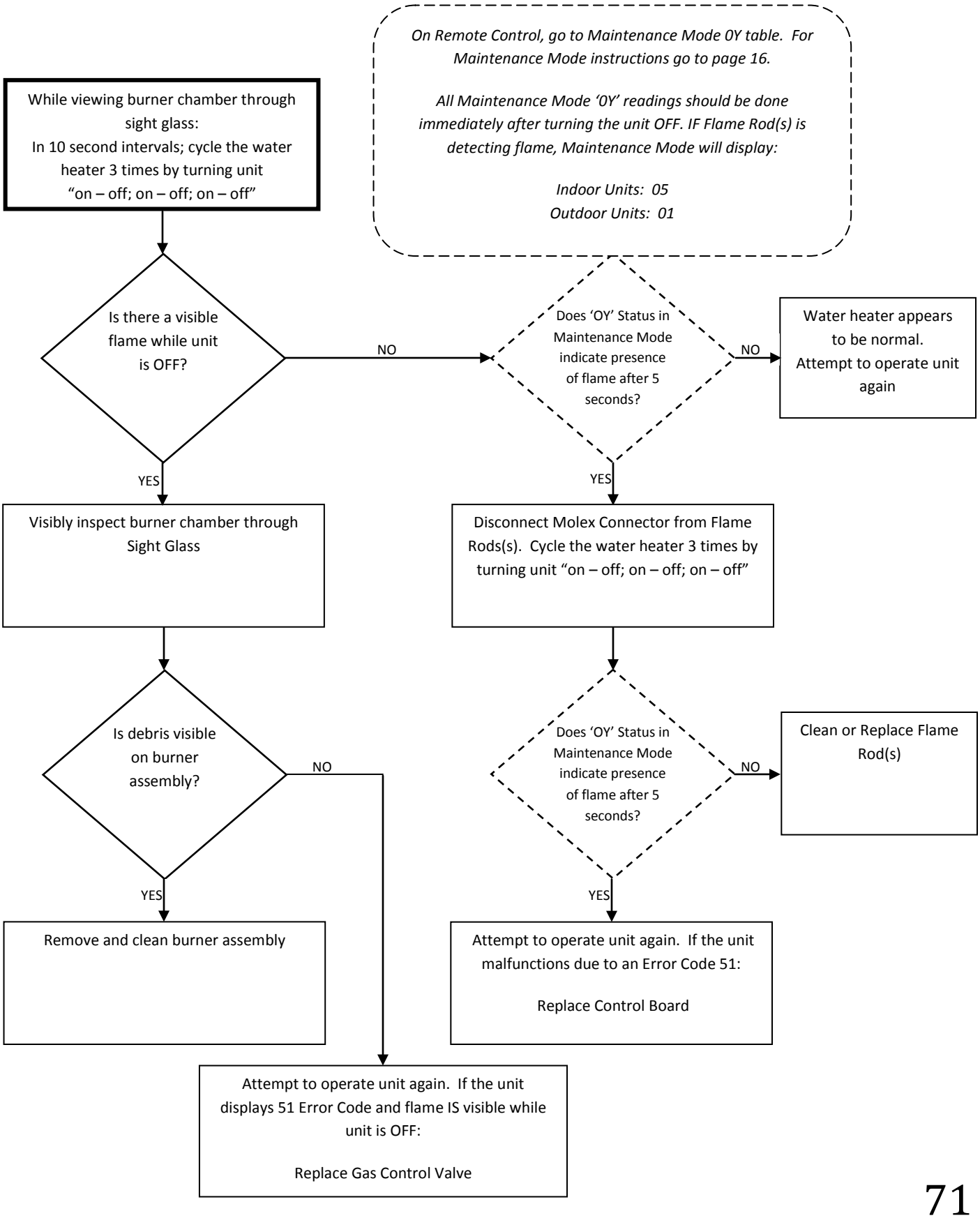
*Indoor Models ONLY:
2 Flame Rods

3



Visually inspect Gas Control Valve wiring harnesses for loose connections or damaged wiring. Gas Control Valve is located on lower right side of unit.
Locate sight glass. Continue to diagnostic chart on next page.

51 – Error Code Diagnostic Chart


On Remote Control, go to Maintenance Mode 0Y table. For Maintenance Mode instructions go to page 16.
All Maintenance Mode '0Y' readings should be done immediately after turning the unit OFF. IF Flame Rod(s) is detecting flame, Maintenance Mode will display:
Indoor Units: 05
Outdoor Units: 01
While viewing burner chamber through sight glass:
In 10 second intervals; cycle the water heater 3 times by turning unit "on – off; on – off; on – off"
Is there a visible flame while unit is OFF?
NO
Does 'OY' Status in Maintenance Mode indicate presence of flame after 5 seconds?
NO
Water heater appears to be normal. Attempt to operate unit again
YES
YES
Visibly inspect burner chamber through Sight Glass
Disconnect Molex Connector from Flame Rods(s). Cycle the water heater 3 times by turning unit "on – off; on – off; on – off"
Is debris visible on burner assembly?
NO
Does 'OY' Status in Maintenance Mode indicate presence of flame after 5 seconds?
NO
Clean or Replace Flame Rod(s)
YES
YES
Remove and clean burner assembly
Attempt to operate unit again. If the unit malfunctions due to an Error Code 51:
Replace Control Board
Attempt to operate unit again. If the unit displays 51 Error Code and flame IS visible while unit is OFF:
Replace Gas Control Valve

52 – Error Code

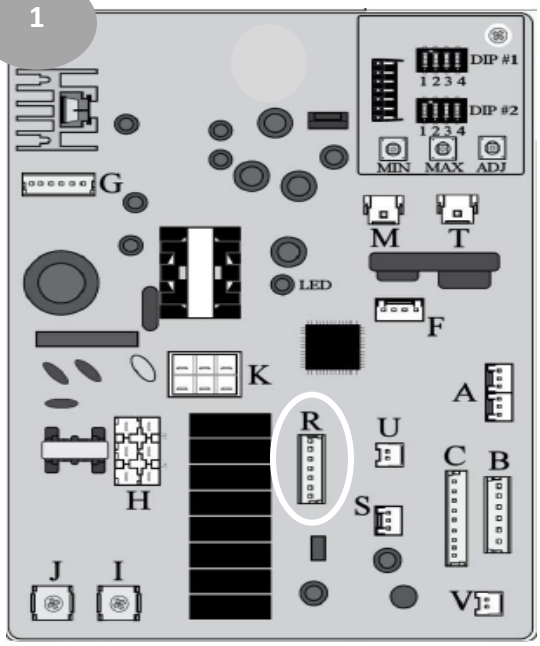
Explanation: PGFR (Proportional Gas Flow Regulator) malfunction. The PGFR is the only modulating valve in the Gas Control Valve.

Diagnostic Checks:

- *PGFR*

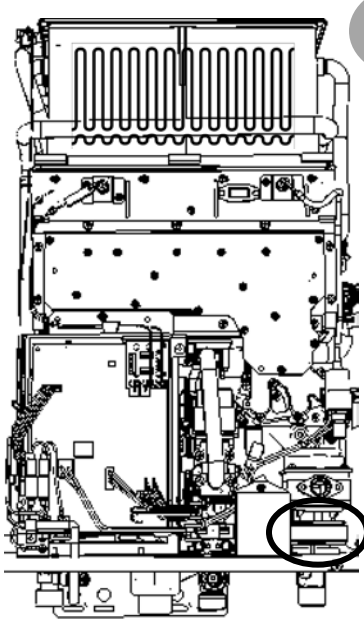
PGFR DIAGNOSTICS:

1



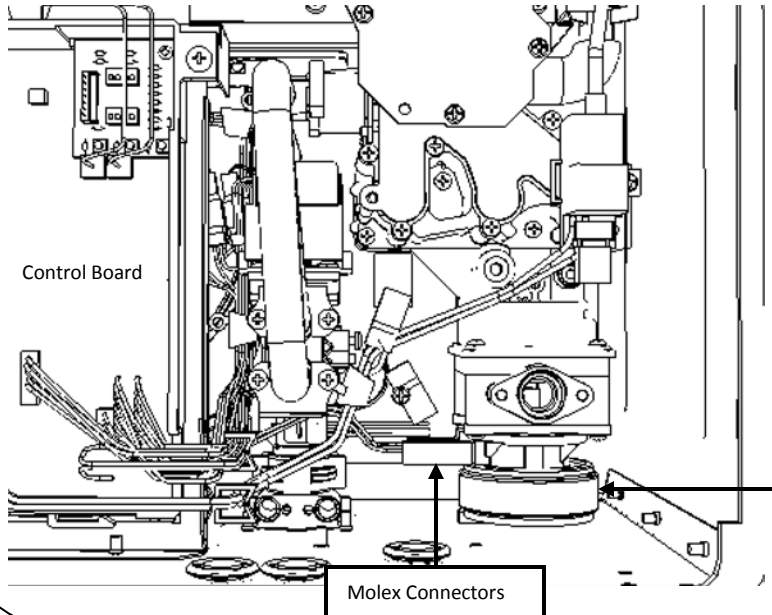
Turn power OFF. Remove and reinsert connector "R" on Control Board.

2



Locate PGFR valve on lower right of unit. Remove and reinsert Molex connector with red wire and Molex connector with black wire on PGFR. Attempt to operate unit again.

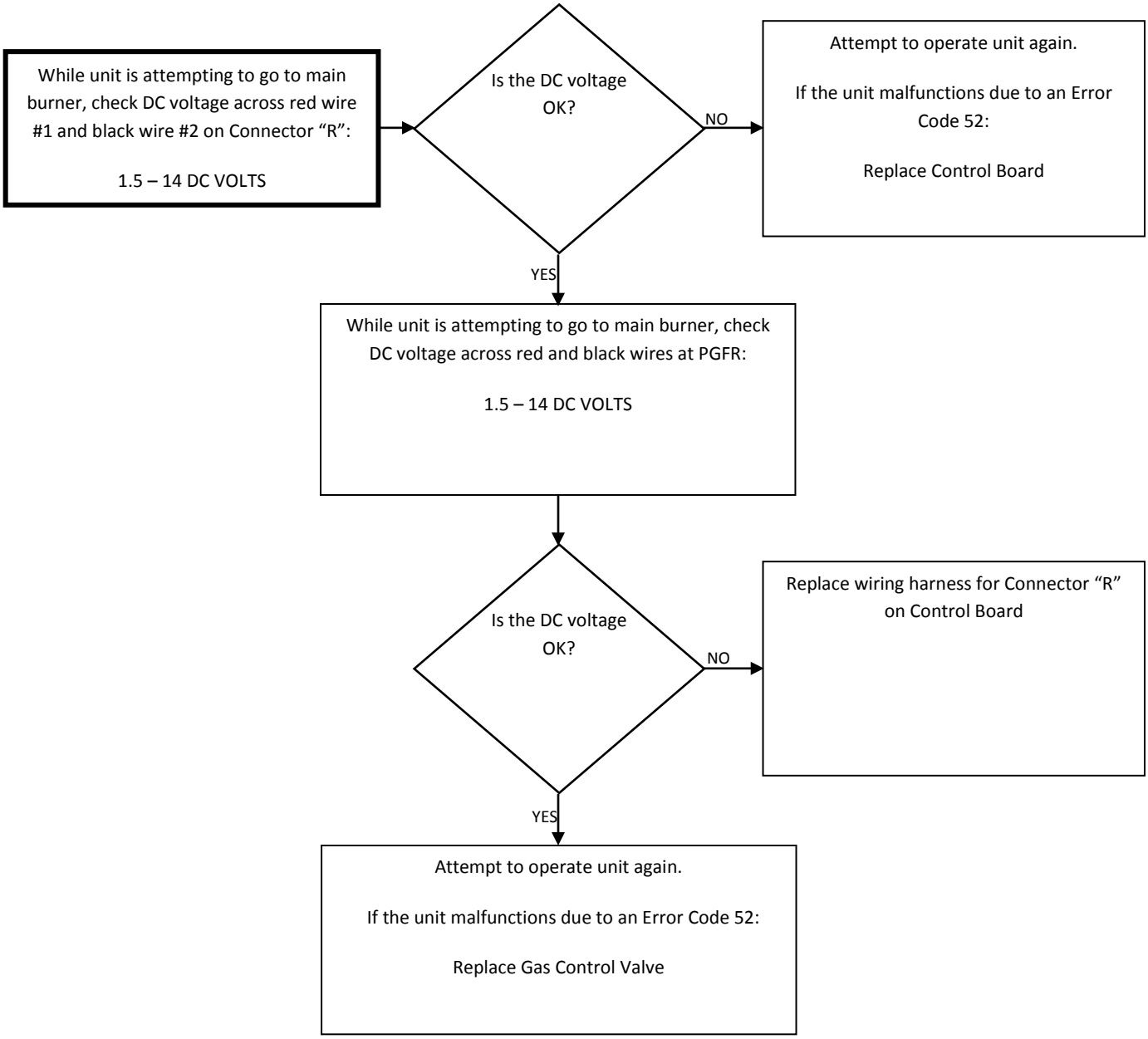
3



IF 52 Error Code does NOT display, unit had a loose connection.

IF 52 Error Code IS displayed, continue to diagnostic chart on next page.

52 – Error Code Diagnostic Chart


While unit is attempting to go to main burner, check DC voltage across red wire #1 and black wire #2 on Connector "R":
1.5 – 14 DC VOLTS
Is the DC voltage OK?
NO
Attempt to operate unit again.
If the unit malfunctions due to an Error Code 52:
Replace Control Board
YES
While unit is attempting to go to main burner, check DC voltage across red and black wires at PGFR:
1.5 – 14 DC VOLTS
Is the DC voltage OK?
NO
Replace wiring harness for Connector "R" on Control Board
YES
Attempt to operate unit again.
If the unit malfunctions due to an Error Code 52:
Replace Gas Control Valve

61 – Error Code

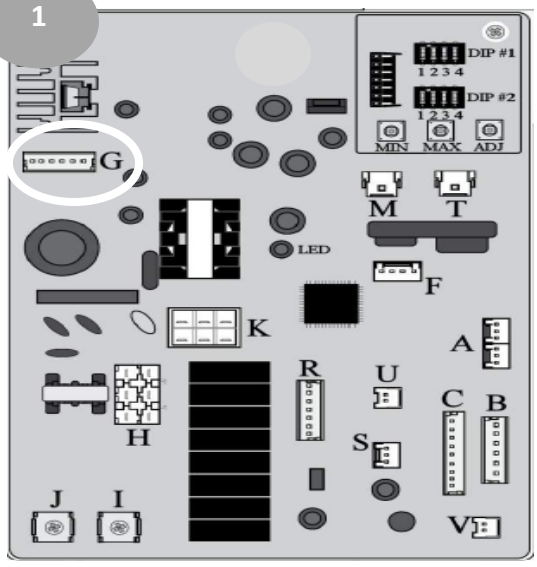
Explanation: Blower Motor malfunction. Blower Motor speed was not appropriate to allow proper combustion.

Diagnostic Checks:

- *Blower Motor*

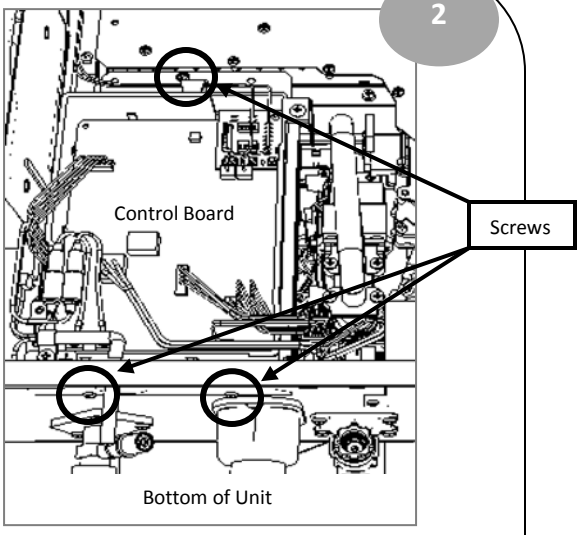
BLOWER MOTOR DIAGNOSTICS:

1



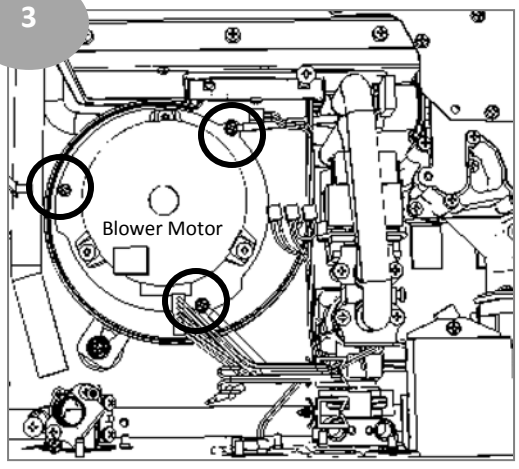
Turn power OFF. Remove and reinsert connector "G" on Control Board. Attempt to operate unit again. IF 61 Error Code does NOT display, unit had a loose connection.

2



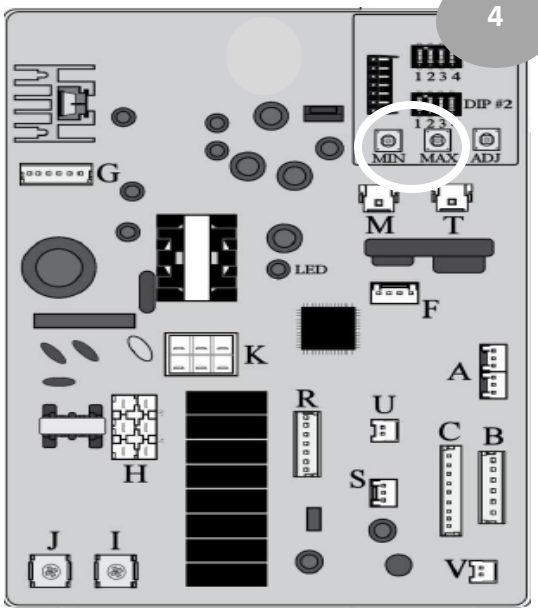
Turn power OFF. Remove 3 screws for Control Board mounting bracket. Remove connectors "M", "T" & "G". Pull Control Board out of way to access Blower Motor.

3



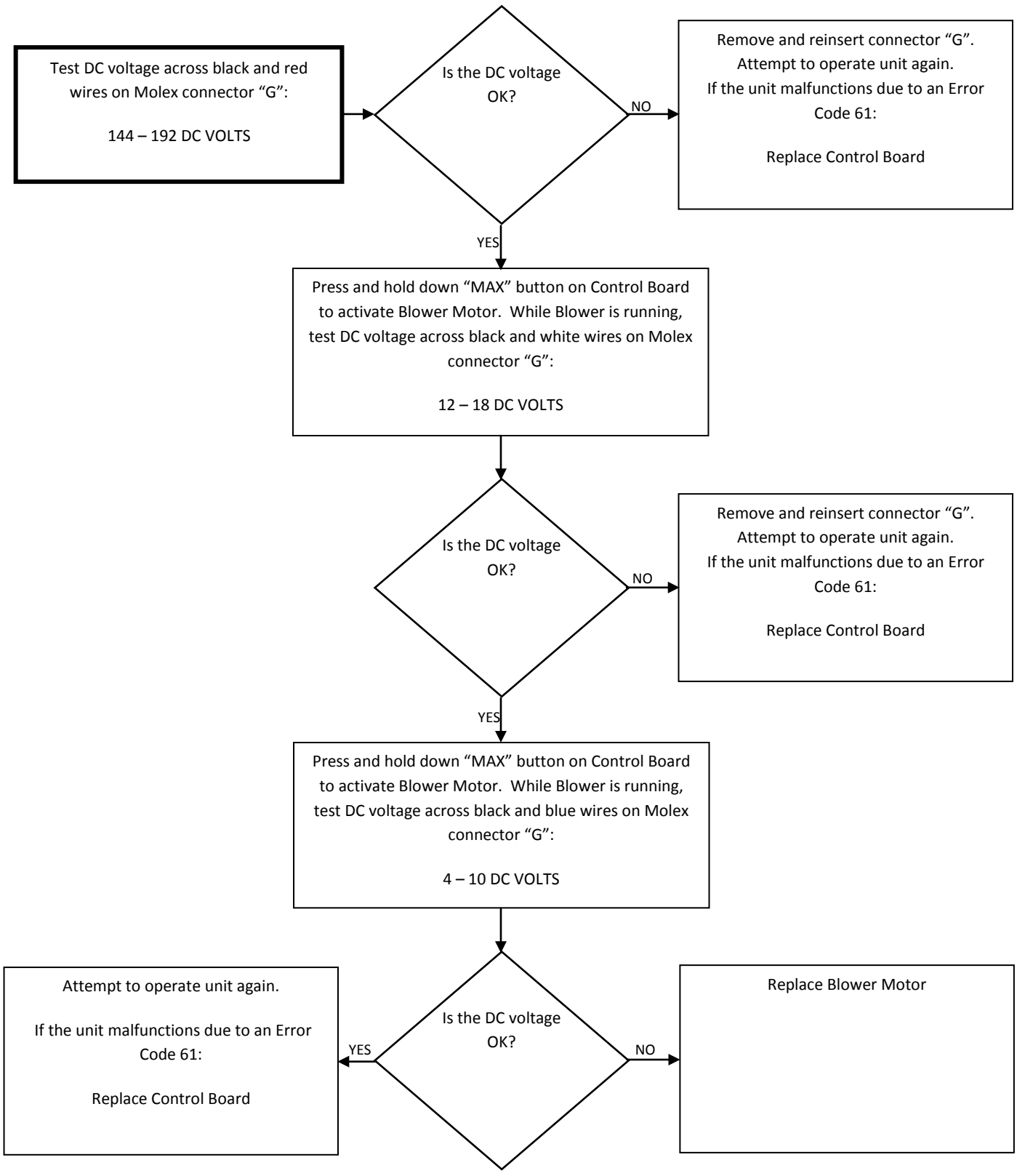
Remove 3 screws holding Blower Motor in place. Clean Blower Motor and reassemble unit. Attempt to operate unit again. IF 61 Error Code does NOT display: Blower Motor needed to be cleaned.

4



Locate Min & Max buttons on Control Board. Continue to diagnostic chart on next page.

61 – Error Code Diagnostic Chart


Test DC voltage across black and red wires on Molex connector "G":
144 – 192 DC VOLTS
Is the DC voltage OK?
NO
Remove and reinsert connector "G". Attempt to operate unit again. If the unit malfunctions due to an Error Code 61:
Replace Control Board
YES
Press and hold down "MAX" button on Control Board to activate Blower Motor. While Blower is running, test DC voltage across black and white wires on Molex connector "G":
12 – 18 DC VOLTS
Is the DC voltage OK?
NO
Remove and reinsert connector "G". Attempt to operate unit again. If the unit malfunctions due to an Error Code 61:
Replace Control Board
YES
Press and hold down "MAX" button on Control Board to activate Blower Motor. While Blower is running, test DC voltage across black and blue wires on Molex connector "G":
4 – 10 DC VOLTS
Is the DC voltage OK?
YES
Attempt to operate unit again.
If the unit malfunctions due to an Error Code 61:
Replace Control Board
NO
Replace Blower Motor

65 – Error Code

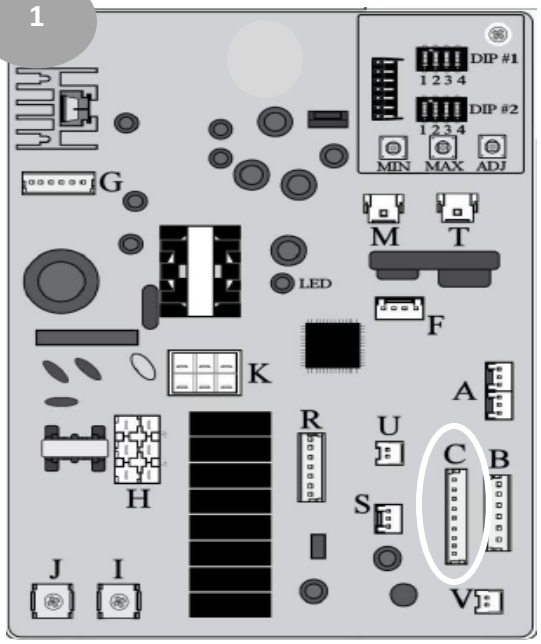
Explanation: Water Control Valve malfunction

Diagnostic Checks:

- Water Control Valve

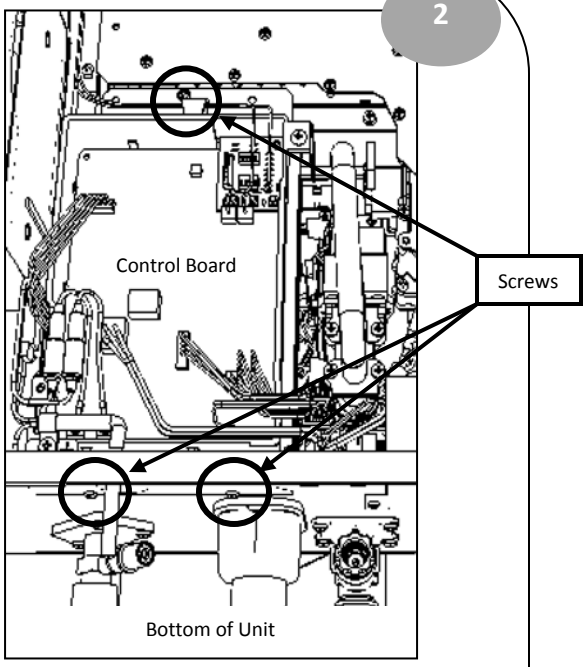
WATER CONTROL VALVE DIAGNOSTICS:

1



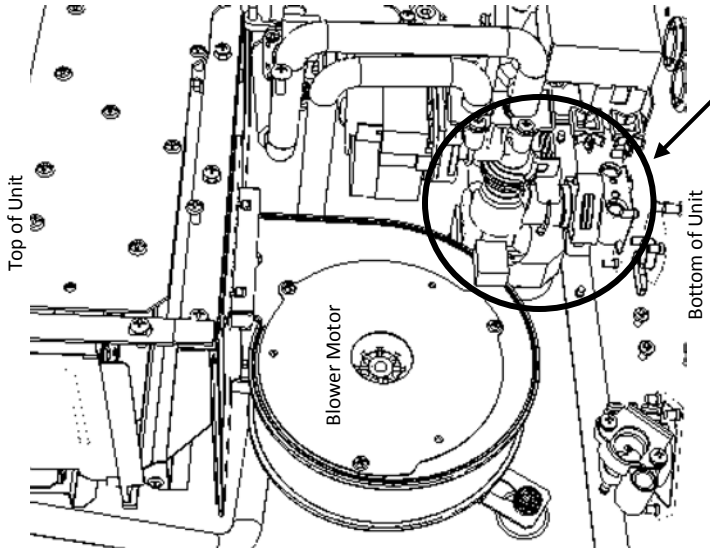
Turn power OFF. Remove and reinsert connector "C" on Control Board. Attempt to operate unit again. IF 65 Error Code does NOT display, unit had a loose connection.

2



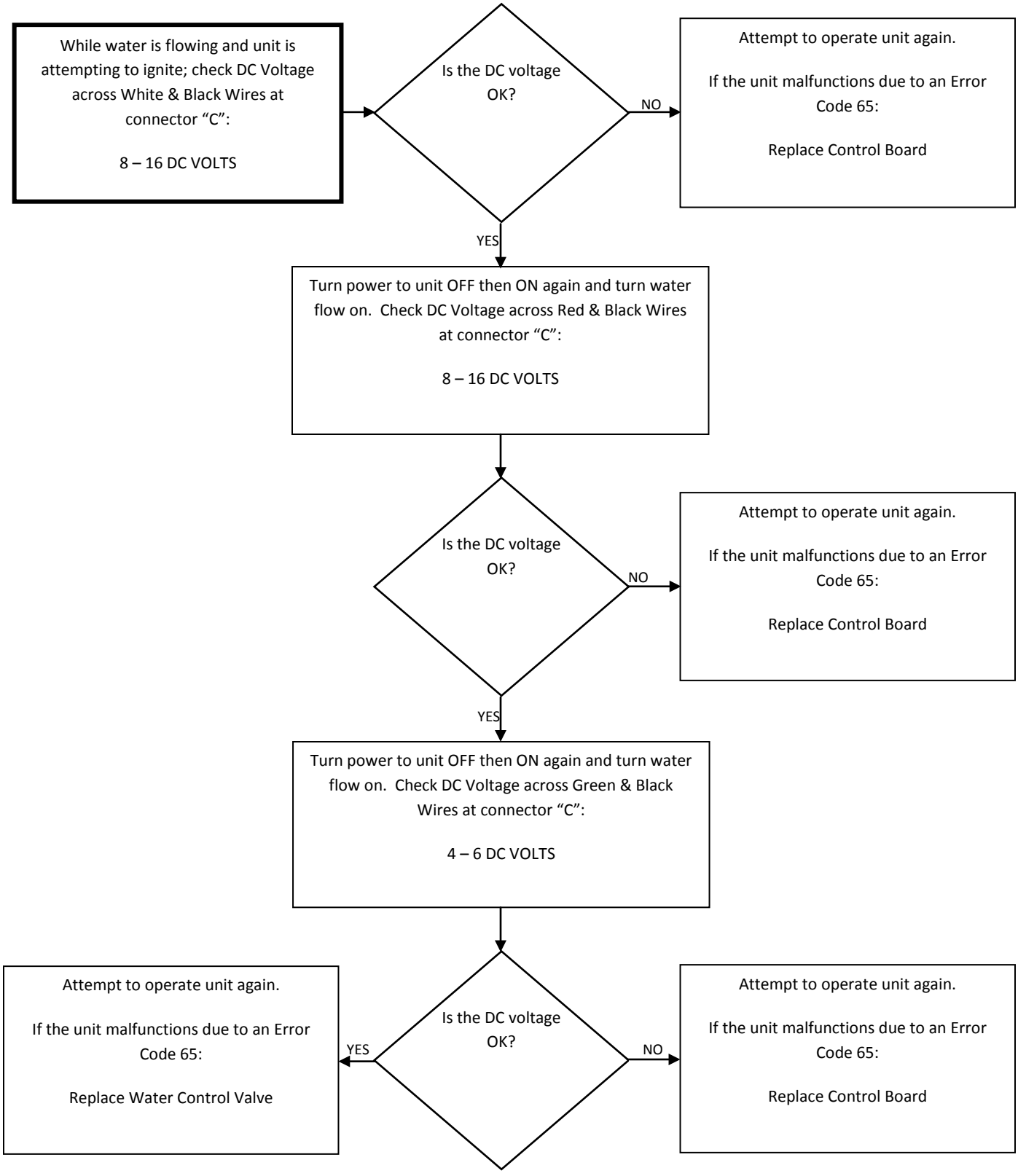
Turn power OFF. Remove 3 screws for Control Board mounting bracket. Remove connectors "M"; "T" & "G". Pull Control Board out of way to access Water Control Valve.

3



Visually inspect Water Control Valve wiring harness for loose or damaged terminals. It is located right of the Blower Motor; connected directly to the water inlet. Reassemble unit and continue to diagnostic chart on next page.

65 – Error Code Diagnostic Chart


While water is flowing and unit is attempting to ignite; check DC Voltage across White & Black Wires at connector "C":
8 – 16 DC VOLTS
Is the DC voltage OK?
NO
Attempt to operate unit again.
If the unit malfunctions due to an Error Code 65:
Replace Control Board
YES
Turn power to unit OFF then ON again and turn water flow on. Check DC Voltage across Red & Black Wires at connector "C":
8 – 16 DC VOLTS
Is the DC voltage OK?
NO
Attempt to operate unit again.
If the unit malfunctions due to an Error Code 65:
Replace Control Board
YES
Turn power to unit OFF then ON again and turn water flow on. Check DC Voltage across Green & Black Wires at connector "C":
4 – 6 DC VOLTS
Is the DC voltage OK?
YES
Attempt to operate unit again.
If the unit malfunctions due to an Error Code 65:
Replace Water Control Valve
NO
Attempt to operate unit again.
If the unit malfunctions due to an Error Code 65:
Replace Control Board

66 – Error Code

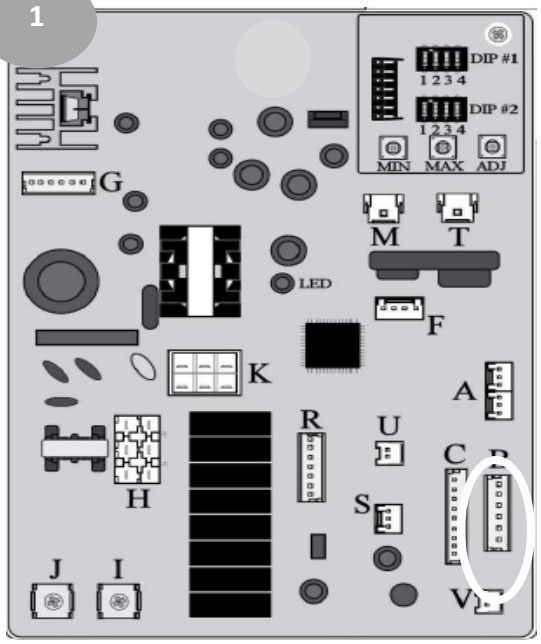
Explanation: Water Bypass Valve malfunction. Hot outlet water temperature is above or below set point on Remote Control.

Diagnostic Checks:

- *Water Bypass Valve*

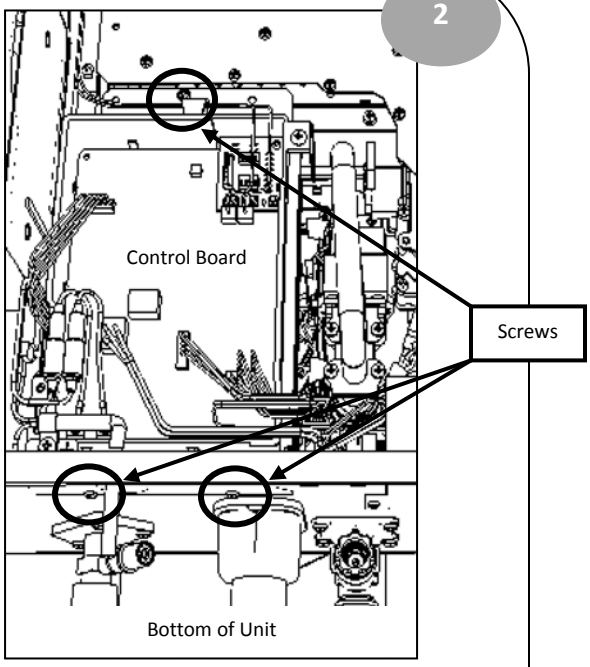
WATER BYPASS VALVE DIAGNOSTICS:

1



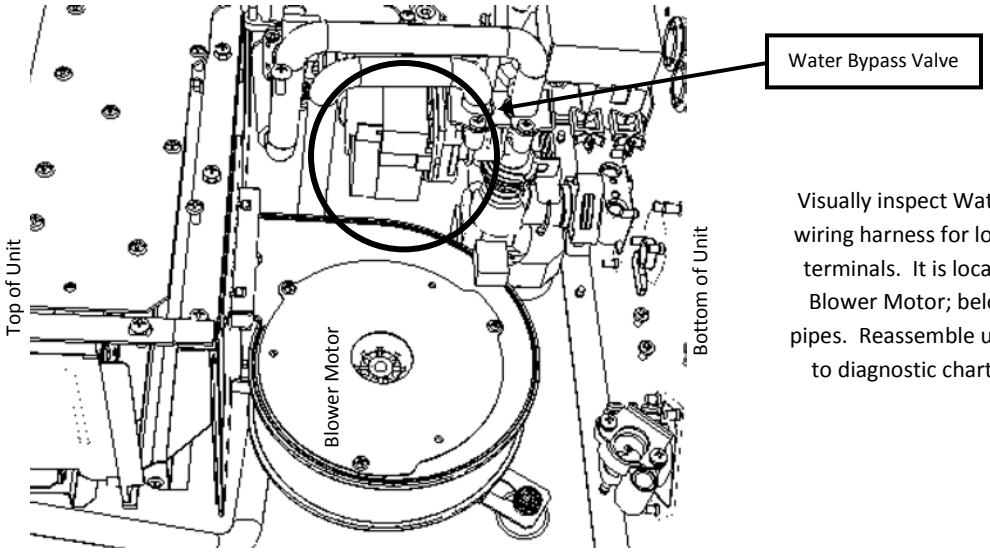
Turn power OFF. Remove and reinsert connector "B" on Control Board. Attempt to operate unit again. IF 66 Error Code does NOT display, unit had a loose connection.

2



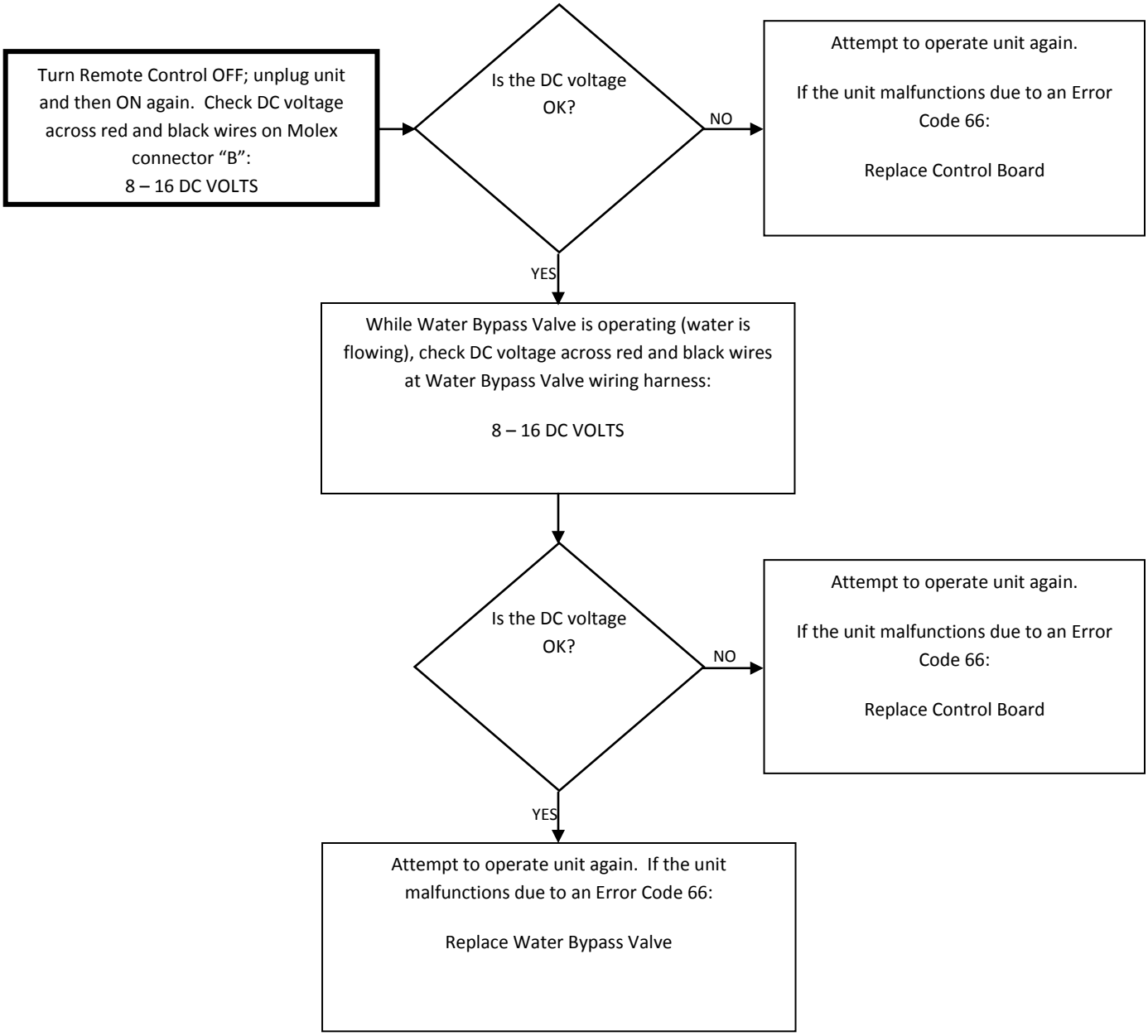
Turn power OFF. Remove 3 screws for Control Board mounting bracket. Remove connectors "M"; "T"; & "G". Pull Control Board out of way to access Water Bypass Valve.

3



Visually inspect Water Bypass Valve wiring harness for loose or damaged terminals. It is located right of the Blower Motor; below two copper pipes. Reassemble unit and continue to diagnostic chart on next page.

66 – Error Code Diagnostic Chart


Turn Remote Control OFF; unplug unit and then ON again. Check DC voltage across red and black wires on Molex connector "B":
8 – 16 DC VOLTS
Is the DC voltage OK?
NO
Attempt to operate unit again.
If the unit malfunctions due to an Error Code 66:
Replace Control Board
YES
While Water Bypass Valve is operating (water is flowing), check DC voltage across red and black wires at Water Bypass Valve wiring harness:
8 – 16 DC VOLTS
Is the DC voltage OK?
NO
Attempt to operate unit again.
If the unit malfunctions due to an Error Code 66:
Replace Control Board
YES
Attempt to operate unit again. If the unit malfunctions due to an Error Code 66:
Replace Water Bypass Valve

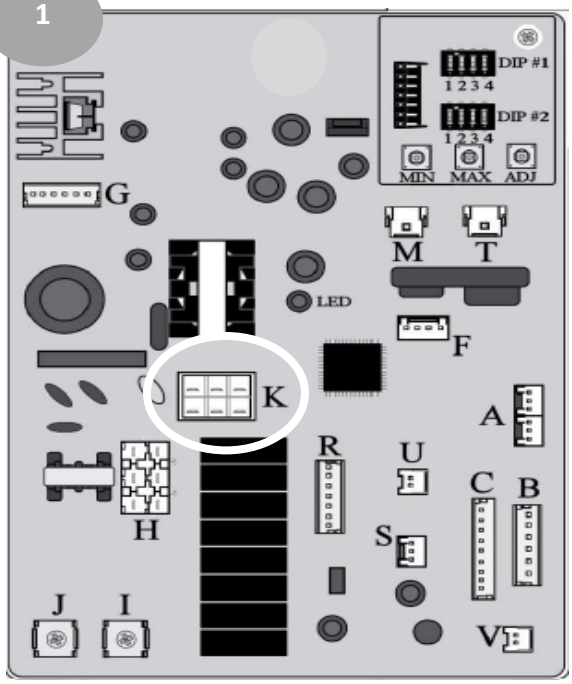
71 – Error Code

Explanation: Gas Control Valve malfunction

Diagnostic Checks: *Gas Control Valve*

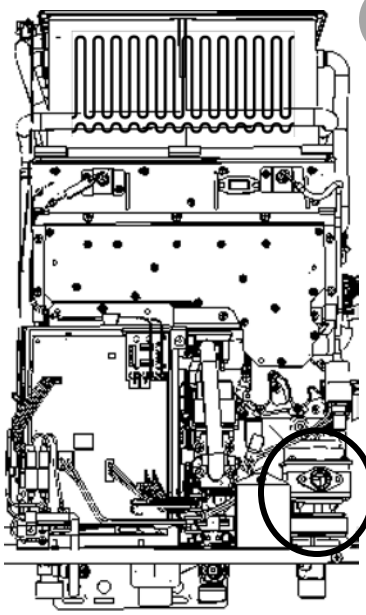
GAS CONTROL VALVE DIAGNOSTICS:

1



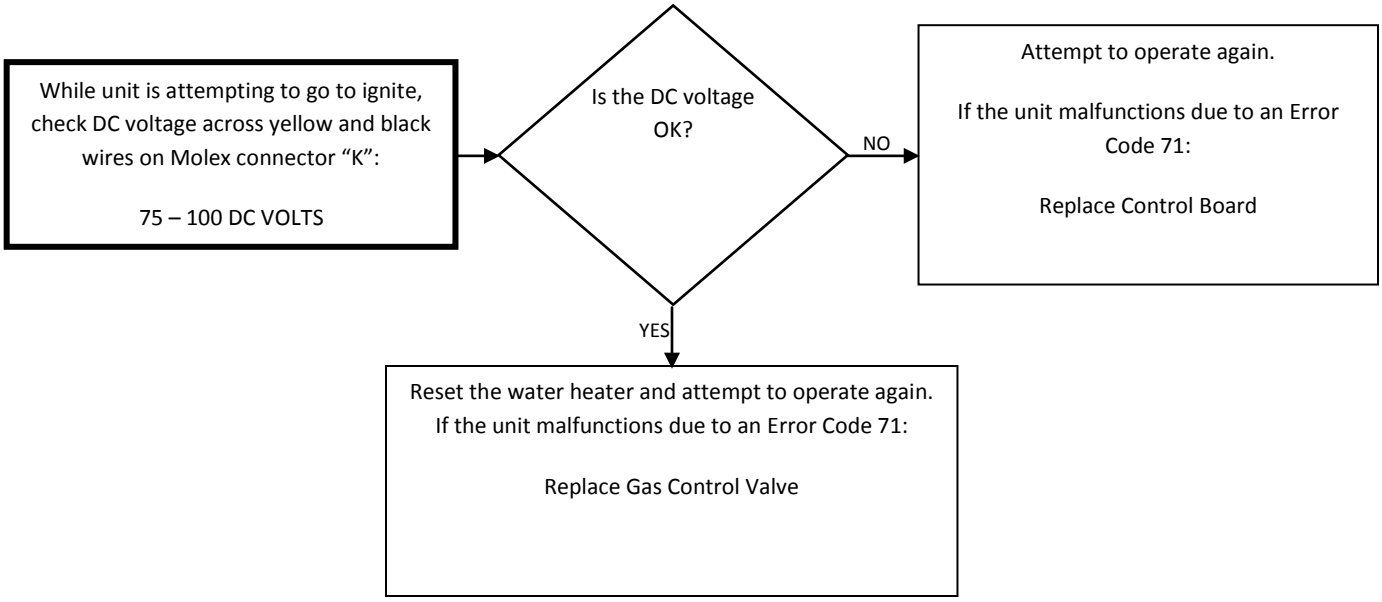
Turn power OFF. Remove and reinsert connector “K” on Control Board. Attempt to operate unit again. IF 71 Error Code does NOT display, unit had a loose connection.

2



Visually inspect Gas Control Valve wiring harnesses for loose or damaged terminals. Gas Control Valve is located on lower right side of unit.
Continue to diagnostic chart on next page.

71 – Error Code Diagnostic Chart


While unit is attempting to go to ignite, check DC voltage across yellow and black wires on Molex connector "K":
75 – 100 DC VOLTS
Is the DC voltage OK?
NO
Attempt to operate again.
If the unit malfunctions due to an Error Code 71:
Replace Control Board
YES
Reset the water heater and attempt to operate again.
If the unit malfunctions due to an Error Code 71:
Replace Gas Control Valve

72 – Error Code

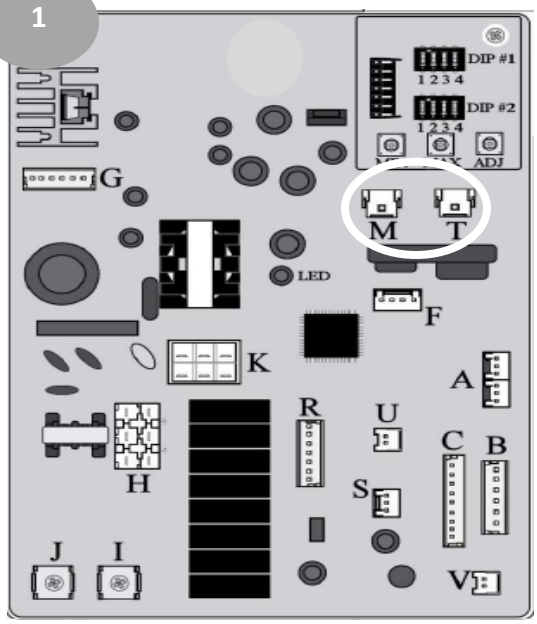
Explanation: Flame Rod(s) malfunction. Flame Rod(s) is detecting the presence of flame BEFORE igniter is activated.

Diagnostic Checks:

- Flame Rod(s)
- Gas Control Valve

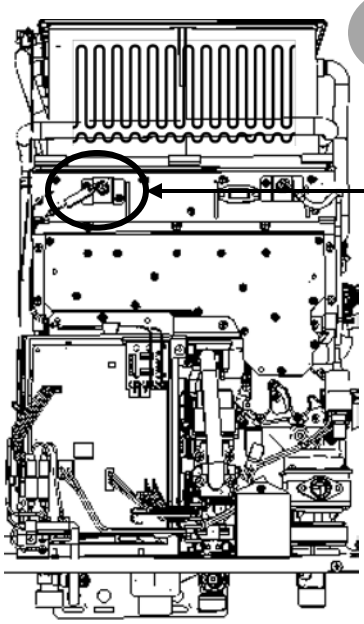
FLAME ROD(s) & GAS CONTROL VALVE DIAGNOSTICS:

1



Turn power OFF. Remove and reinsert white connector “M” and blue connector “T” on Control Board.

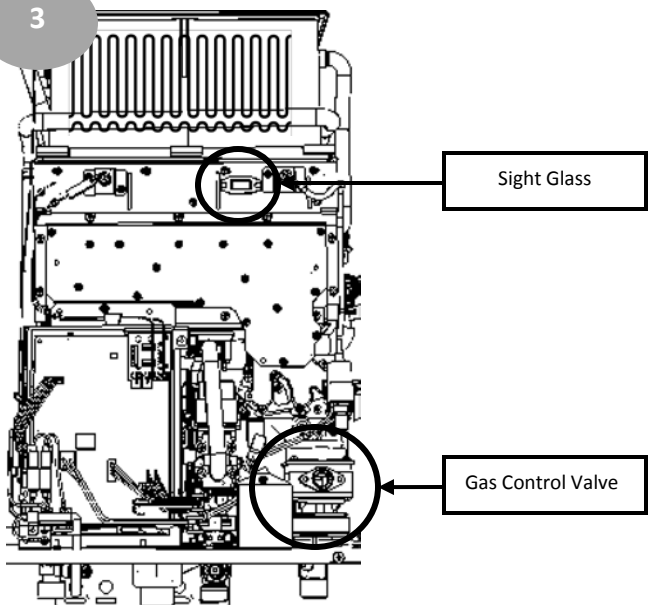
2



Remove and reinsert terminals on Flame Rod(s)*. Attempt to operate unit again. IF 72 Error Code does NOT display, unit had a loose connection.

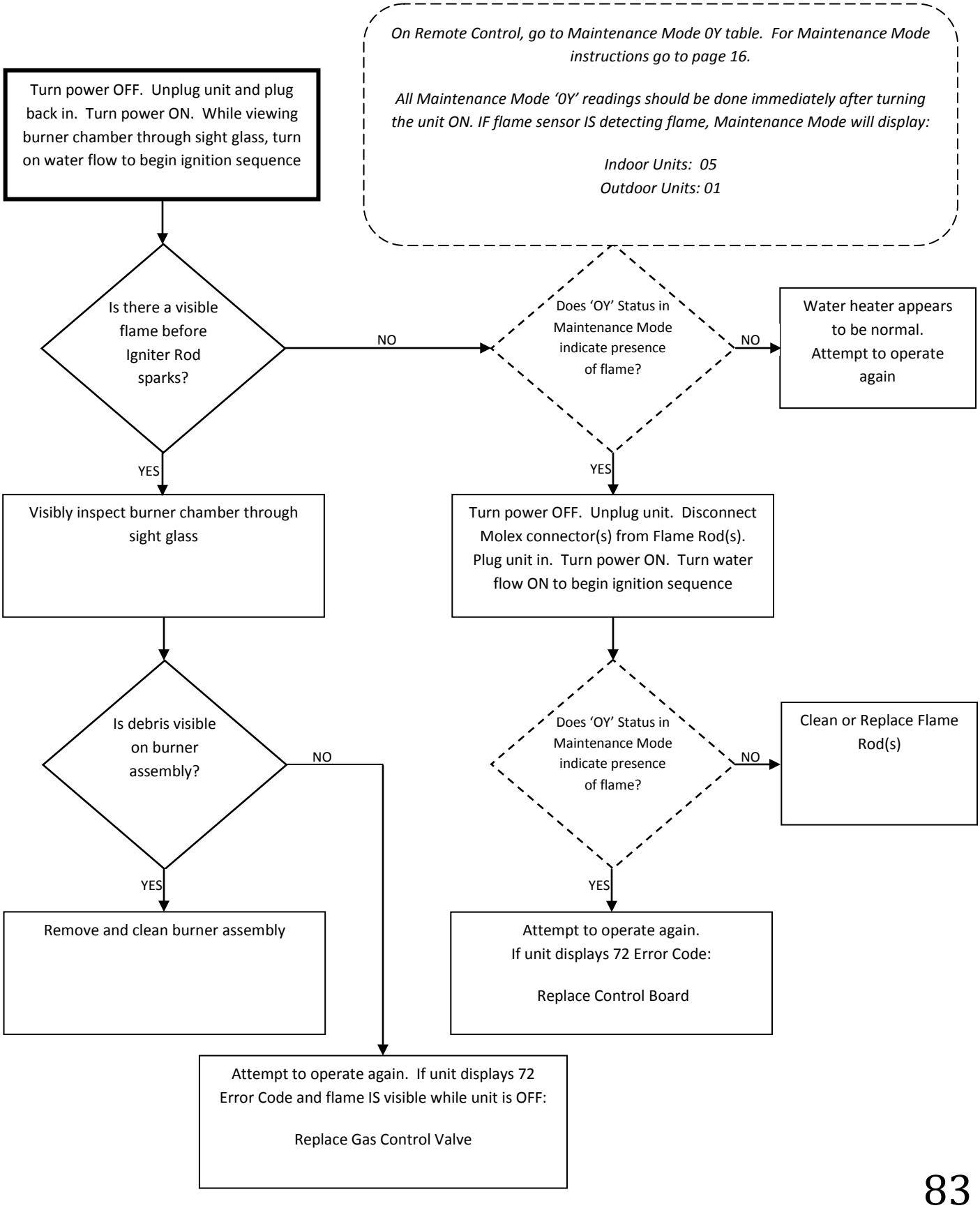
*Indoor Units ONLY:
2 Flame Rods

3



Visually inspect Gas Control Valve wiring harnesses for loose connections or damaged wiring. Gas Control Valve is located on lower right side of unit. Locate Sight Glass. Continue to diagnostic chart on next page.

72 – Error Code Diagnostic Chart


On Remote Control, go to Maintenance Mode 0Y table. For Maintenance Mode instructions go to page 16.
All Maintenance Mode '0Y' readings should be done immediately after turning the unit ON. IF flame sensor IS detecting flame, Maintenance Mode will display:
Indoor Units: 05
Outdoor Units: 01
Turn power OFF. Unplug unit and plug back in. Turn power ON. While viewing burner chamber through sight glass, turn on water flow to begin ignition sequence
Is there a visible flame before Igniter Rod sparks?
NO
Does 'OY' Status in Maintenance Mode indicate presence of flame?
NO
Water heater appears to be normal. Attempt to operate again
YES
YES
Visibly inspect burner chamber through sight glass
Turn power OFF. Unplug unit. Disconnect Molex connector(s) from Flame Rod(s). Plug unit in. Turn power ON. Turn water flow ON to begin ignition sequence
Is debris visible on burner assembly?
NO
Does 'OY' Status in Maintenance Mode indicate presence of flame?
NO
Clean or Replace Flame Rod(s)
YES
YES
Remove and clean burner assembly
Attempt to operate again.
If unit displays 72 Error Code:
Replace Control Board
Attempt to operate again. If unit displays 72 Error Code and flame IS visible while unit is OFF:
Replace Gas Control Valve

76 – Error Code

Explanation: Communication Fault with Remote Control. Remote Control is not communicating with Control Board

Diagnostic Checks:

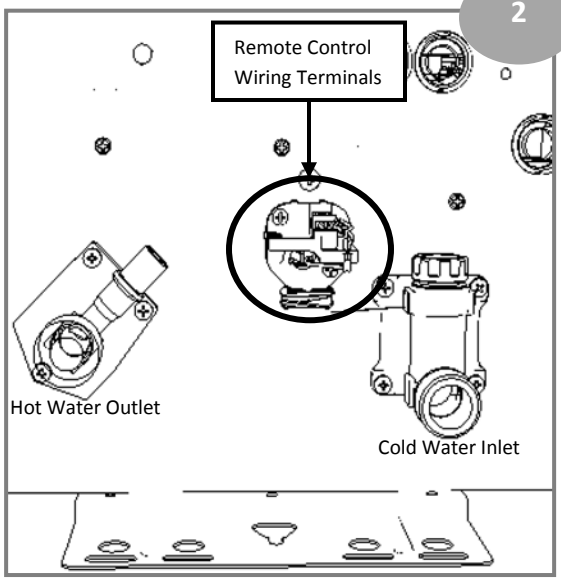
- Remote Control
- Wiring

REMOTE THERMOSTAT DIAGNOSTICS:

1

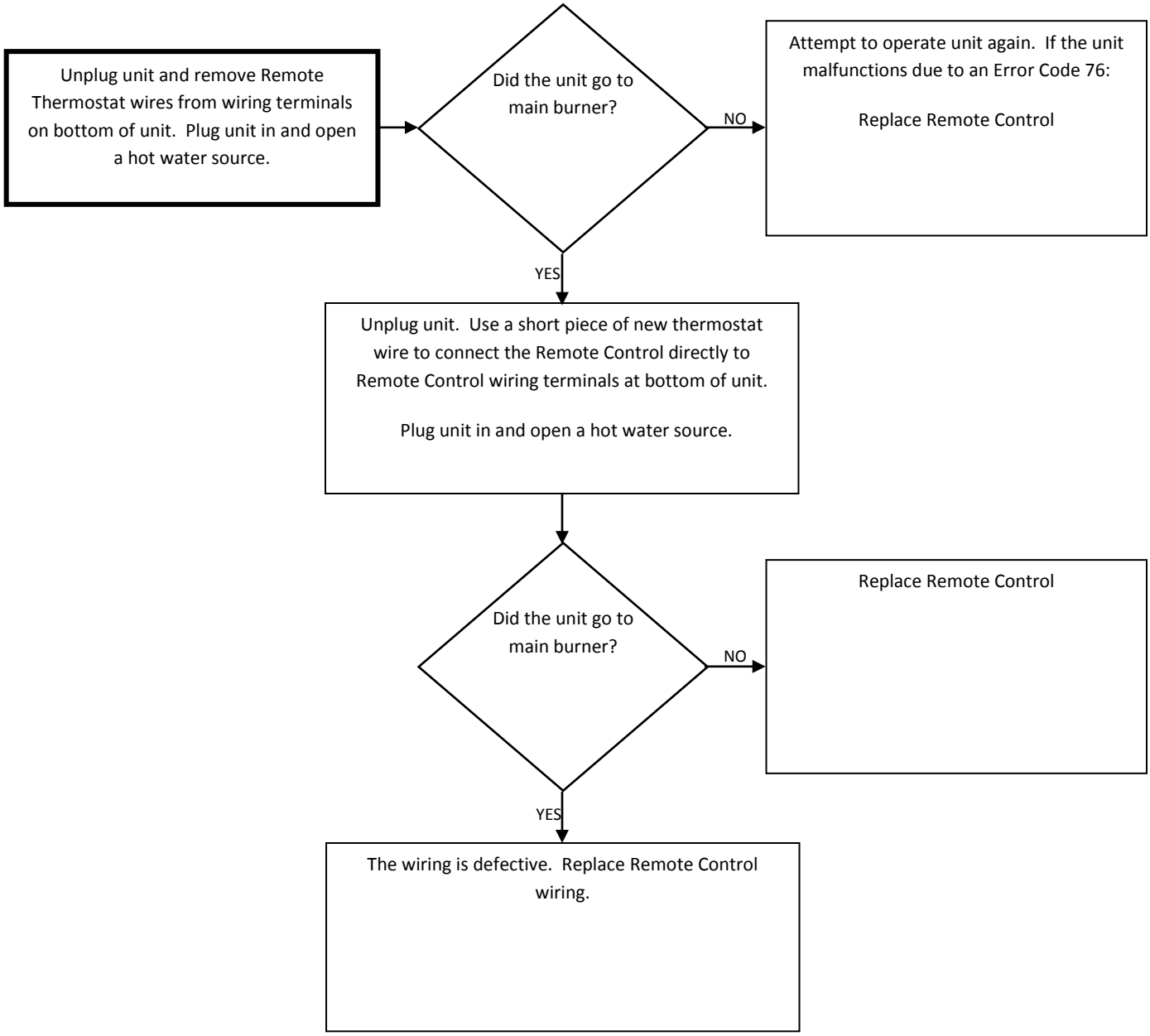
Visually inspect Remote Control wiring for damaged or loose terminals.

2



Turn power OFF. Remove and reconnect Remote Control wiring terminals at bottom of unit. Attempt to operate unit again. IF 76 Error Code does NOT display, unit had a loose connection.
IF 76 Error Code IS displayed, continue to diagnostic chart on next page.

76 – Error Code Diagnostic Chart


Unplug unit and remove Remote Thermostat wires from wiring terminals on bottom of unit. Plug unit in and open a hot water source.
Did the unit go to main burner?
NO
Attempt to operate unit again. If the unit malfunctions due to an Error Code 76:
Replace Remote Control
YES
Unplug unit. Use a short piece of new thermostat wire to connect the Remote Control directly to Remote Control wiring terminals at bottom of unit.
Plug unit in and open a hot water source.
Did the unit go to main burner?
NO
Replace Remote Control
YES
The wiring is defective. Replace Remote Control wiring.

79 – Error Code

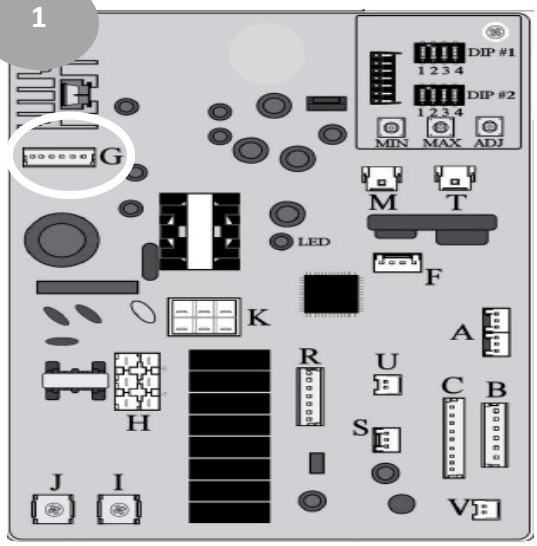
Explanation: Blower Motor current fault. The unit detected a fault with the Blower Motor.

Diagnostic Checks:

- *Blower Motor*

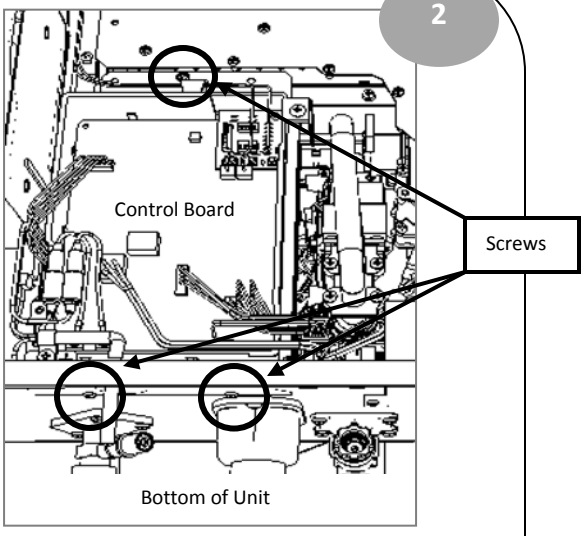
BLOWER MOTOR DIAGNOSTICS:

1



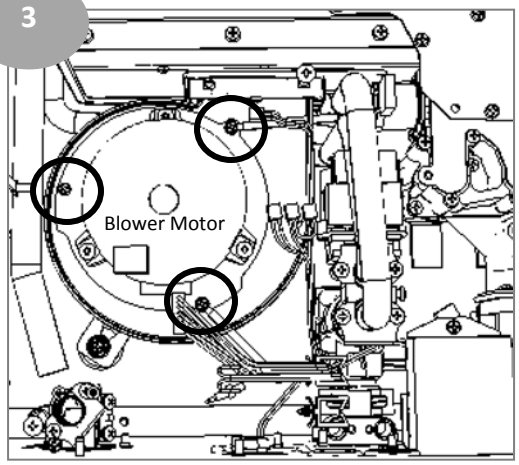
Turn power OFF. Remove and reinsert connector "G" on Control Board. Attempt to operate unit again. IF 79 Error Code does NOT display, unit had a loose connection.

2



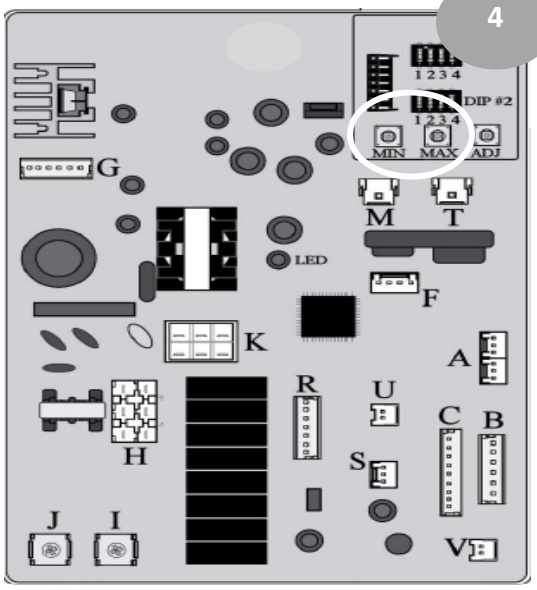
Turn power OFF. Remove 3 screws for Control Board mounting bracket. Remove connectors "M", "T" & "G". Pull Control Board out of way to access Blower Motor.

3



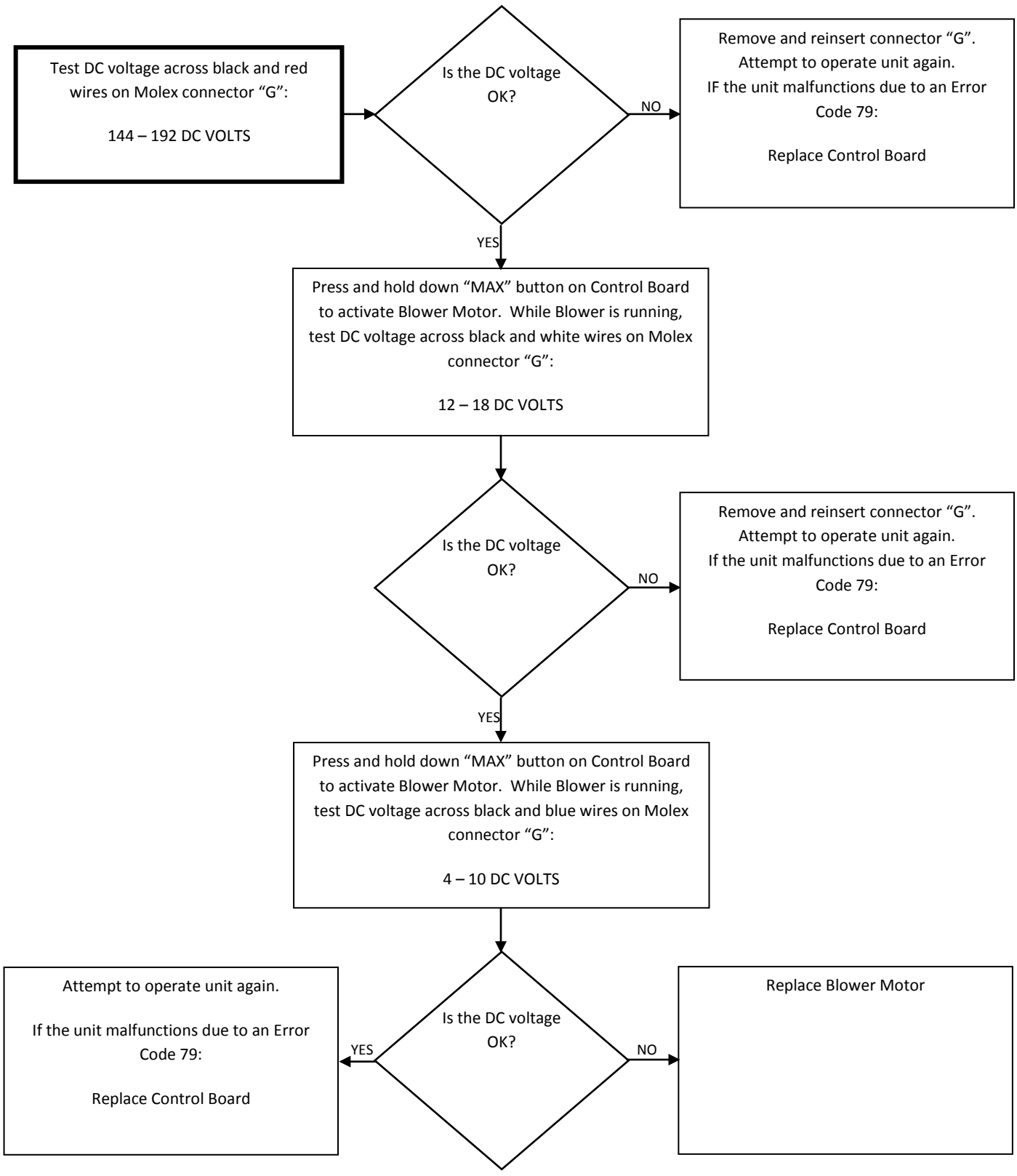
Remove 3 screws holding Blower Motor in place. Clean Blower Motor and reassemble unit. Attempt to operate unit again. IF 79 Error Code does NOT display: Blower Motor needed to be cleaned.

4



Locate Min & Max buttons on Control Board. Continue to diagnostic chart on next page.

79 – Error Code Diagnostic Chart


Test DC voltage across black and red wires on Molex connector "G":
144 – 192 DC VOLTS
Is the DC voltage OK?
NO
Remove and reinsert connector "G". Attempt to operate unit again. IF the unit malfunctions due to an Error Code 79:
Replace Control Board
YES
Press and hold down "MAX" button on Control Board to activate Blower Motor. While Blower is running, test DC voltage across black and white wires on Molex connector "G":
12 – 18 DC VOLTS
Is the DC voltage OK?
NO
Remove and reinsert connector "G". Attempt to operate unit again. If the unit malfunctions due to an Error Code 79:
Replace Control Board
YES
Press and hold down "MAX" button on Control Board to activate Blower Motor. While Blower is running, test DC voltage across black and blue wires on Molex connector "G":
4 – 10 DC VOLTS
Is the DC voltage OK?
YES
Attempt to operate unit again.
If the unit malfunctions due to an Error Code 79:
Replace Control Board
NO
Replace Blower Motor

80 – Error Code

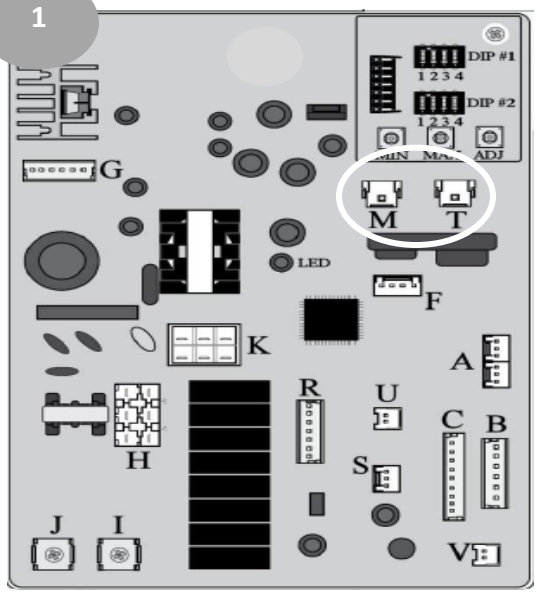
Explanation: Gas Control Valve malfunction. The unit detects the presence of flame when the demand for hot water is terminated and burner is OFF. This error code will only occur at time of shut down.

Diagnostic Checks:

- *Flame Rod(s)*
- *Gas Control Valve*

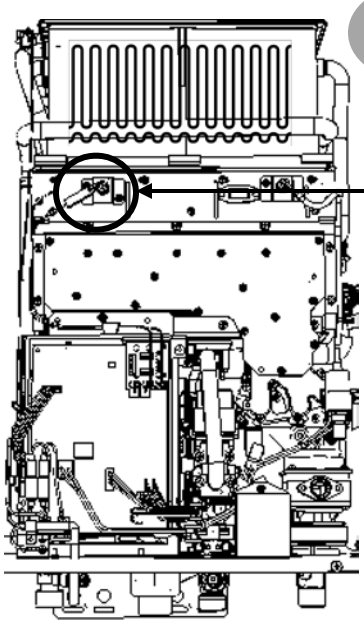
FLAME ROD(s) & GAS CONTROL VALVE DIAGNOSTICS:

1



Turn power OFF. Remove and reinsert white connector “M” and blue connector “T” on Control Board.

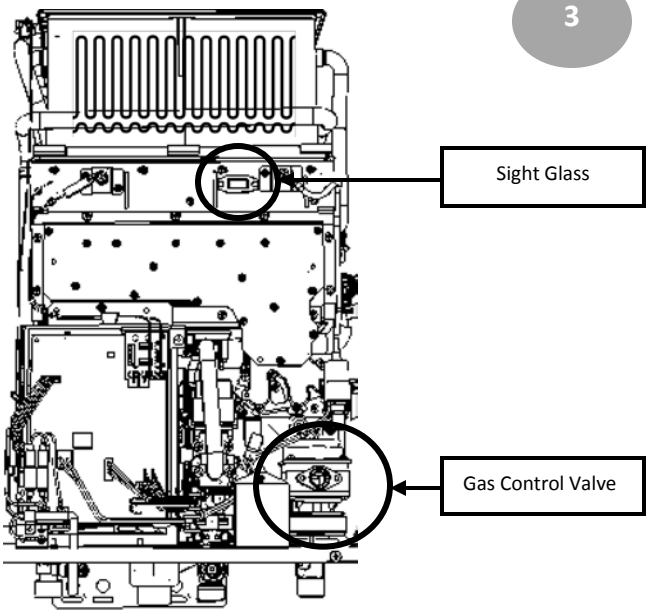
2



Remove and reinsert terminals on Flame Rod(s)*. Attempt to operate unit again. IF 80 Error Code does NOT display, unit had a loose connection.

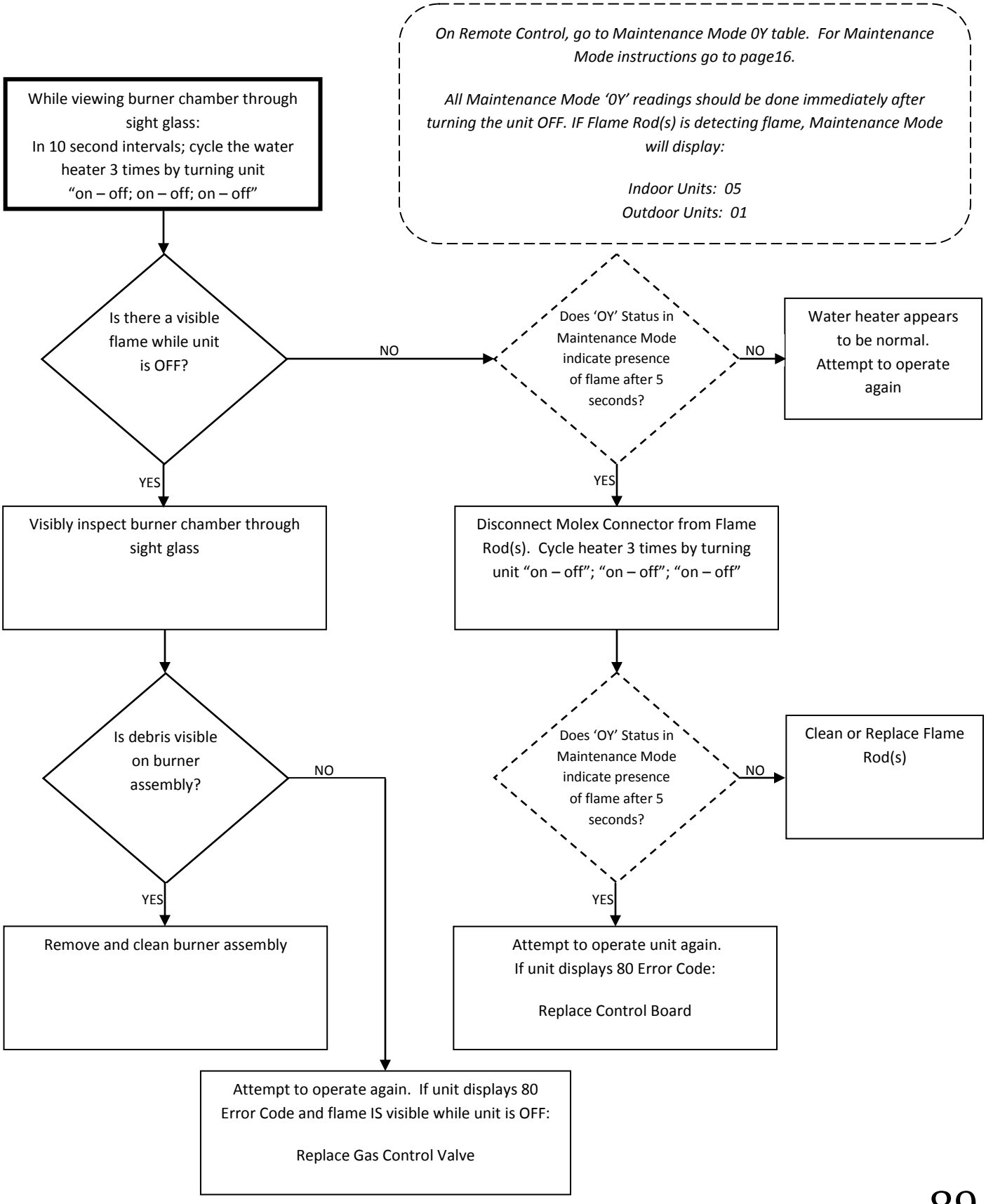
*Indoor Units ONLY:
2 Flame Rods

3



Visually inspect Gas Control Valve wiring harnesses for loose connection or damaged wiring. Gas Control Valve is located on lower right side of unit. Locate Sight Glass. Continue to diagnostic chart on next page.

80 – Error Code Diagnostic Chart


On Remote Control, go to Maintenance Mode 0Y table. For Maintenance Mode instructions go to page16.
All Maintenance Mode '0Y' readings should be done immediately after turning the unit OFF. IF Flame Rod(s) is detecting flame, Maintenance Mode will display:
Indoor Units: 05
Outdoor Units: 01
While viewing burner chamber through sight glass:
In 10 second intervals; cycle the water heater 3 times by turning unit "on – off; on – off; on – off"
Is there a visible flame while unit is OFF?
NO
Does 'OY' Status in Maintenance Mode indicate presence of flame after 5 seconds?
NO
Water heater appears to be normal. Attempt to operate again
YES
YES
Visibly inspect burner chamber through sight glass
Disconnect Molex Connector from Flame Rod(s). Cycle heater 3 times by turning unit "on – off"; "on – off"; "on – off"
Is debris visible on burner assembly?
NO
Does 'OY' Status in Maintenance Mode indicate presence of flame after 5 seconds?
NO
Clean or Replace Flame Rod(s)
YES
YES
Remove and clean burner assembly
Attempt to operate unit again.
If unit displays 80 Error Code:
Replace Control Board
Attempt to operate again. If unit displays 80 Error Code and flame IS visible while unit is OFF:
Replace Gas Control Valve

82 – Error Code

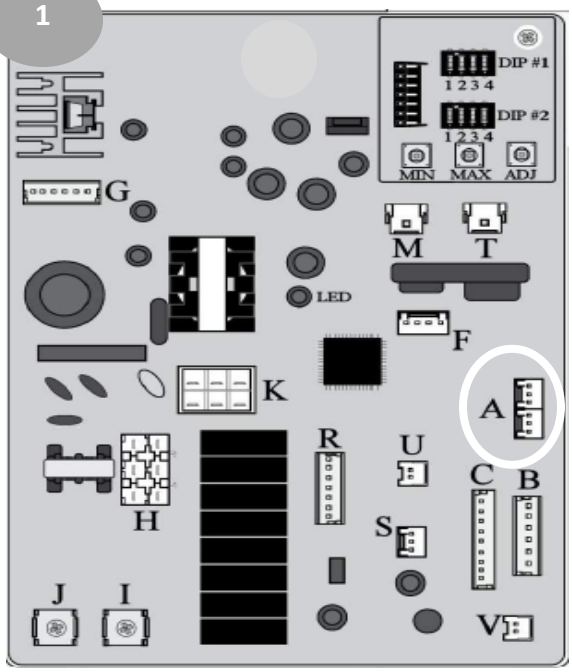
Explanation: Control Board Program Chip malfunction

Diagnostic Checks:

- Program Chip

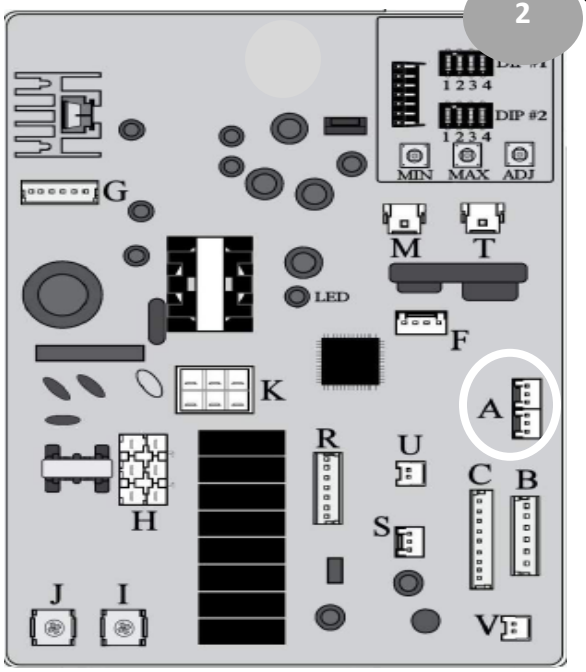
PROGRAM CHIP DIAGNOSTICS:

1



Turn power OFF. Verify you have a Program Chip inserted in connector “A”.

2



Remove and reinsert Program Chip. Attempt to operate unit again.
IF unit does NOT display 82 Error Code, unit had a loose connection.

90 – Error Code

Explanation: The unit detected blockage in the venting during pre-purge cycle. This Error Code will occur BEFORE unit goes to ignition.

Possible Causes:

- VENTING

VENTING:

****REFER TO USE & CARE MANUAL****

Visually inspect venting for possible blockage and/or recirculation of exhaust.

1. Approved Venting Materials
2. Approved Vent Terminations
3. Vent Lengths
4. Location Of Vent Termination (Recirculation of exhaust)
5. Blocked Venting
6. Venting Not Sealed Properly

92 – Error Code

Explanation: High Efficiency Condensing Units ONLY. This is a warning code and unit will continue to operate but will eventually shut down due to an error code 93. REPLACE NEUTRALIZER ASAP.

***Once Neutralizer is replaced; follow reset procedures on page 21.**

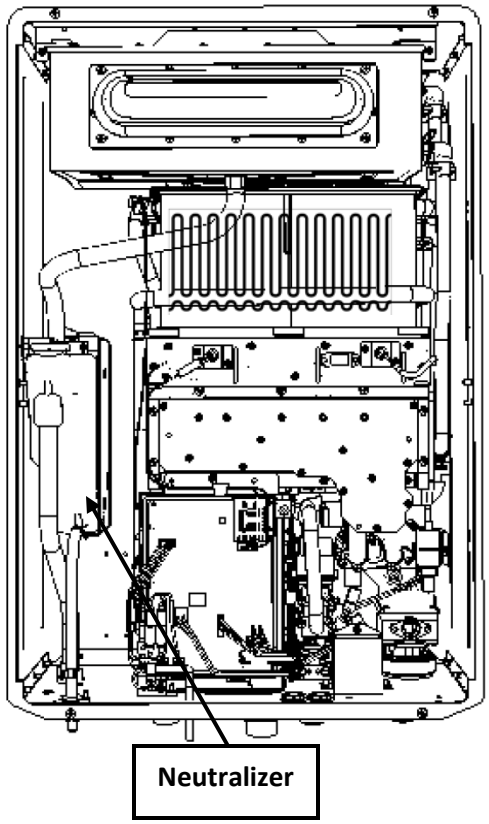
93 – Error Code

Explanation: High Efficiency Condensing Units ONLY. Unit will NOT operate until the Neutralizer is replaced. REPLACE NEUTRALIZER IMMEDIATELY.

Neutralizer rocks made from Calcium Carbonate ($CACO_3$).

Neutralizer Kit may be ordered through Rheem Supplier.

***Once Neutralizer is replaced; follow reset procedures on page 21.**



99 – Error Code

Explanation: The unit detected blockage in the venting during post-purge cycle. Blockage was detected when the demand for hot water terminated and burner was OFF. This error code will only occur at time of shut down.

***Unit must be reset by performing reset procedure on page 21.**

Possible Causes:

- Venting

VENTING:

****REFER TO USE & CARE MANUAL****

Visually inspect venting for possible blockage and/or recirculation of exhaust.

1. Approved Venting Materials
2. Approved Vent Terminations
3. Vent Lengths
4. Location Of Vent Termination (Recirculation of exhaust)
5. Blocked Venting
6. Venting Not Sealed Properly

Diagnostic Points on Printed Circuit Board

Measurement Point		**Normal Value**	**What you are checking?**
Connection	**Wire Color**		
I – J		AC 108 – 132V	Do you have power to the control board?
U	W1 – W2	50K Ω – 500K Ω	Is the Over Heat Film Wrap OK?
S	BR1 – BK2	DC 2 - 5V (pulse) More than 1,310 pulses/minute	Does the water flow sensor send a pulse? (Only when water is flowing thru control)
	R3 – BK2	DC 11 – 17 V	Does the water flow sensor have voltage? (Power ON; no water flow)
G	BK4 – R6	DC 144 – 192 V	Does the fan motor have the proper voltage?
	W3 – BK4	DC 12 - 18 V	Does the fan motor have proper voltage?
	BL1 – BK4	DC 4 – 10 (Pulse)	Is the fan motor producing a regular pulse?
R	W6 – BK3	68^0F = @ 10.3 KΩ 104^0F = @ 4.9 KΩ	Is the Inlet Thermistor working?
R	Y5 – BK3 *Condensing ONLY: G5-BK3*	68^0F = @ 10.3 KΩ 104^0F = @ 4.9 KΩ	Is the Heat Exchanger Thermistor working?
R	R4 – BK3	68^0F = @ 10.3 KΩ 104^0F = @ 4.9 KΩ	Is the Outlet Thermistor working?

R	Bl7 – BK3	All Mid Efficiency Indoor Units ONLY: 68^0F = @ 10.3 KΩ 104^0F = @ 4.9 KΩ All Outdoor & All Condensing Units ONLY: 68^0F = @ 6.2 KΩ 104^0F = @ 2.6 KΩ	Is the Ambient Thermistor working?
R	R1 – BK2	DC 1.5 - 14 V 40 – 80Ω	Is the P.G.F.R. valve operating? (Proportional Gas Flow Regulating Valve)
M	W1 – GND	AC 1 – 100 V	Flame Rod(s) detecting flame?
T	BL1 – GND	AC 1 – 100 V	
H	GY3 – GY4	AC 108 - 132 V	Is the igniter working properly
K	Y1 – BK6	DC 90 - 120 V 0.8 – 2.4 KΩ	Gas Inlet Solenoid Valve Okay?
K	W2- BK6	DC 90 - 120 V 0.8 – 2.4 KΩ	Solenoid Valve 1 Okay?
K	GY3- BK6	DC 90 - 120 V 0.8 – 2.4 KΩ	Solenoid Valve 2 Okay?
K	R5- BK6	DC 90 - 120 V 0.8 – 2.4 KΩ	Solenoid Valve 3 Okay?
K	BL4- BK6	DC 90 - 120 V 0.8 – 2.4 KΩ	Solenoid Valve 4 Okay?

C	W2 – BK8	DC 8 – 16V	Does the water volume control motor have proper voltage?
	R7 – BK8	DC 8 – 16V	Does the water volume control motor have proper voltage?
	G6 – BK8	Less than 1V DC (Limiter on) DC4 – 6 V (Limiter Off)	Is the water volume control position switch OK?
B	W2 – BK8	DC 8 – 16V	Does the water by-pass control motor have proper voltage?
	R7 – BK8	DC 8 – 16V	Does the water by-pass control motor have proper voltage?
	G6 – BK8	Less than 1V DC (Limiter on) DC4 – 6 V (Limiter Off)	Is the water by-pass control position switch OK?

Inlet, Outlet, & Heat Exchanger Thermistor – All Models

RESISTANCE CHART

(°C)	(°F)	(kΩ)	(V)
-25	-13.00	87.7437	4.746
-24	-11.20	82.9816	4.732
-23	-9.40	78.5129	4.718
-22	-7.60	74.3177	4.703
-21	-5.80	70.3773	4.687
-20	-4.00	66.6745	4.671
-19	-2.20	63.1933	4.654
-18	-0.40	59.9192	4.636
-17	1.40	56.8382	4.618
-16	3.20	53.9378	4.599
-15	5.00	51.2062	4.580
-14	6.80	48.6325	4.559
-13	8.60	46.2064	4.538
-12	10.40	43.9185	4.517
-11	12.20	41.7602	4.494
-10	14.00	39.7230	4.471
-9	15.80	37.7996	4.447
-8	17.60	35.9828	4.422
-7	19.40	34.2660	4.397
-6	21.20	32.6430	4.371
-5	23.00	31.1082	4.344
-4	24.80	29.6561	4.316
-3	26.60	28.2819	4.287
-2	28.40	26.9807	4.258
-1	30.20	25.7484	4.228
0	32.00	24.5807	4.197
1	33.80	23.4739	4.166
2	35.60	22.4245	4.134
3	37.40	21.4291	4.101
4	39.20	20.4846	4.067
5	41.00	19.5880	4.032
6	42.80	18.7367	3.997
7	44.60	17.9281	3.961
8	46.40	17.1598	3.925
9	48.20	16.4295	3.888
10	50.00	15.7351	3.850
11	51.80	15.0746	3.812
12	53.60	14.4462	3.773
13	55.40	13.8482	3.733
14	57.20	13.2787	3.693
15	59.00	12.7365	3.652
16	60.80	12.2199	3.611
17	62.60	11.7275	3.569
18	64.40	11.2582	3.527
19	66.20	10.8107	3.485
20	68.00	10.3839	3.442
21	69.80	9.9767	3.399
22	71.60	9.5880	3.355
23	73.40	9.2169	3.311
24	75.20	8.8626	3.267
25	77.00	8.5241	3.223
26	78.80	8.2007	3.178
27	80.60	7.8915	3.134
28	82.40	7.5960	3.089
29	84.20	7.3134	3.044
30	86.00	7.0431	2.999
31	87.80	6.7844	2.954
32	89.60	6.5368	2.909
33	91.40	6.2998	2.864
34	93.20	6.0729	2.819
35	95.00	5.8555	2.774
36	96.80	5.6473	2.729
37	98.60	5.4477	2.684
38	100.40	5.2564	2.640
39	102.20	5.0729	2.595
40	104.00	4.8970	2.551
41	105.80	4.7282	2.507
42	107.60	4.5663	2.464
43	109.40	4.4109	2.421
44	111.20	4.2617	2.378
45	113.00	4.1185	2.335
46	114.80	3.9809	2.293
47	116.60	3.8487	2.251
48	118.40	3.7217	2.210
49	120.20	3.5996	2.169
50	122.00	3.4823	2.128
51	123.80	3.3695	2.088
52	125.60	3.2610	2.048
53	127.40	3.1566	2.009
54	129.20	3.0562	1.970
55	131.00	2.9595	1.932
56	132.80	2.8665	1.894
57	134.60	2.7769	1.857
58	136.40	2.6906	1.820
59	138.20	2.6076	1.784
60	140.00	2.5275	1.749
61	141.80	2.4504	1.713
62	143.60	2.3760	1.679
63	145.40	2.3044	1.645
64	147.20	2.2353	1.612
65	149.00	2.1687	1.579
66	150.80	2.1044	1.546
67	152.60	2.0424	1.515
68	154.40	1.9826	1.483
69	156.20	1.9248	1.453
70	158.00	1.8691	1.423
71	159.80	1.8153	1.393
72	161.60	1.7633	1.364
73	163.40	1.7131	1.336
74	165.20	1.6646	1.308
75	167.00	1.6178	1.280
76	168.80	1.5725	1.253
77	170.60	1.5288	1.227
78	172.40	1.4865	1.201
79	174.20	1.4456	1.176
80	176.00	1.4060	1.151
81	177.80	1.3678	1.127
82	179.60	1.3308	1.103
83	181.40	1.2949	1.080
84	183.20	1.2603	1.057
85	185.00	1.2268	1.035
86	186.80	1.1943	1.013
87	188.60	1.1629	0.992
88	190.40	1.1324	0.971
89	192.20	1.1029	0.950
90	194.00	1.0744	0.930
91	195.80	1.0467	0.911
92	197.60	1.0199	0.892
93	199.40	0.9939	0.873
94	201.20	0.9687	0.854
95	203.00	0.9443	0.837
96	204.80	0.9207	0.819
97	206.60	0.8977	0.802
98	208.40	0.8754	0.785
99	210.20	0.8538	0.769
100	212.00	0.8329	0.753

Ambient Thermistor – *RTG64X; RTG84X; RTG95X; RTGH95X; RTGH95DV*

RESISTANCE CHART

(°C)	(°F)	(kΩ)	(V)
-25	-13.00	72.1585	4.694
-24	-11.20	67.6926	4.675
-23	-9.40	63.5355	4.656
-22	-7.60	59.6638	4.635
-21	-5.80	56.0560	4.613
-20	-4.00	52.6923	4.591
-19	-2.20	49.5546	4.567
-18	-0.40	46.6262	4.542
-17	1.40	43.8917	4.516
-16	3.20	41.3370	4.490
-15	5.00	38.9491	4.462
-14	6.80	36.7159	4.433
-13	8.60	34.6266	4.402
-12	10.40	32.6707	4.371
-11	12.20	30.8391	4.339
-10	14.00	29.1229	4.305
-9	15.80	27.5141	4.271
-8	17.60	26.0053	4.235
-7	19.40	24.5897	4.198
-6	21.20	23.2609	4.160
-5	23.00	22.0130	4.120
-4	24.80	20.8406	4.080
-3	26.60	19.7387	4.038
-2	28.40	18.7025	3.996
-1	30.20	17.7277	3.952
0	32.00	16.8103	3.908
1	33.80	15.9466	3.862
2	35.60	15.1330	3.815
3	37.40	14.3664	3.767
4	39.20	13.6438	3.719
5	41.00	12.9623	3.669
6	42.80	12.3194	3.619
7	44.60	11.7126	3.568
8	46.40	11.1397	3.516
9	48.20	10.5986	3.464
10	50.00	10.0873	3.411
11	51.80	9.6040	3.357
12	53.60	9.1470	3.303
13	55.40	8.7148	3.248
14	57.20	8.3058	3.193
15	59.00	7.9186	3.138
16	60.80	7.5519	3.082
17	62.60	7.2046	3.026
18	64.40	6.8755	2.970
19	66.20	6.5635	2.914
20	68.00	6.2677	2.857
21	69.80	5.9870	2.801
22	71.60	5.7207	2.745
23	73.40	5.4680	2.689
24	75.20	5.2280	2.633
25	77.00	5.0000	2.577
26	78.80	4.7834	2.522
27	80.60	4.5775	2.467
28	82.40	4.3818	2.412
29	84.20	4.1957	2.358
30	86.00	4.0186	2.305
31	87.80	3.8500	2.251
32	89.60	3.6896	2.199
33	91.40	3.5369	2.147
34	93.20	3.3914	2.096
35	95.00	3.2528	2.045
36	96.80	3.1207	1.995
37	98.60	2.9947	1.946
38	100.40	2.8746	1.898
39	102.20	2.7600	1.850
40	104.00	2.6507	1.803
41	105.80	2.5464	1.757
42	107.60	2.4468	1.712
43	109.40	2.3517	1.667
44	111.20	2.2609	1.624
45	113.00	2.1741	1.581
46	114.80	2.0911	1.540
47	116.60	2.0118	1.499
48	118.40	1.9360	1.459
49	120.20	1.8635	1.420
50	122.00	1.7941	1.381
51	123.80	1.7277	1.344
52	125.60	1.6641	1.307
53	127.40	1.6033	1.272
54	129.20	1.5450	1.237
55	131.00	1.4892	1.203
56	132.80	1.4357	1.170
57	134.60	1.3845	1.138
58	136.40	1.3354	1.106
59	138.20	1.2883	1.076
60	140.00	1.2431	1.046
61	141.80	1.1997	1.017
62	143.60	1.1582	0.989
63	145.40	1.1183	0.961
64	147.20	1.0800	0.934
65	149.00	1.0432	0.908
66	150.80	1.0079	0.883
67	152.60	0.9739	0.858
68	154.40	0.9413	0.834
69	156.20	0.9100	0.811
70	158.00	0.8799	0.788
71	159.80	0.8510	0.767
72	161.60	0.8231	0.745
73	163.40	0.7964	0.724
74	165.20	0.7706	0.704
75	167.00	0.7458	0.685
76	168.80	0.7220	0.666
77	170.60	0.6990	0.647
78	172.40	0.6769	0.629
79	174.20	0.6557	0.612
80	176.00	0.6352	0.595
81	177.80	0.6154	0.579
82	179.60	0.5964	0.563
83	181.40	0.5781	0.548
84	183.20	0.5604	0.533
85	185.00	0.5433	0.518
86	186.80	0.5269	0.504
87	188.60	0.5111	0.490
88	190.40	0.4958	0.477
89	192.20	0.4810	0.464
90	194.00	0.4668	0.452
91	195.80	0.4531	0.440
92	197.60	0.4398	0.428
93	199.40	0.4270	0.416
94	201.20	0.4146	0.405
95	203.00	0.4027	0.395
96	204.80	0.3911	0.384
97	206.60	0.3800	0.374
98	208.40	0.3692	0.364
99	210.20	0.3588	0.355
100	212.00	0.3488	0.345

Ambient Thermistor – *RTG64DV; RTG84DV; RTG95DV*

RESISTANCE CHART

(°C)	(°F)	(kΩ)	(V)
-25	-13.00	87.7437	4.746
-24	-11.20	82.9816	4.732
-23	-9.40	78.5129	4.718
-22	-7.60	74.3177	4.703
-21	-5.80	70.3773	4.687
-20	-4.00	66.6745	4.671
-19	-2.20	63.1933	4.654
-18	-0.40	59.9192	4.636
-17	1.40	56.8382	4.618
-16	3.20	53.9378	4.599
-15	5.00	51.2062	4.580
-14	6.80	48.6325	4.559
-13	8.60	46.2064	4.538
-12	10.40	43.9185	4.517
-11	12.20	41.7602	4.494
-10	14.00	39.7230	4.471
-9	15.80	37.7996	4.447
-8	17.60	35.9828	4.422
-7	19.40	34.2660	4.397
-6	21.20	32.6430	4.371
-5	23.00	31.1082	4.344
-4	24.80	29.6561	4.316
-3	26.60	28.2819	4.287
-2	28.40	26.9807	4.258
-1	30.20	25.7484	4.228
0	32.00	24.5807	4.197
1	33.80	23.4739	4.166
2	35.60	22.4245	4.134
3	37.40	21.4291	4.101
4	39.20	20.4846	4.067
5	41.00	19.5880	4.032
6	42.80	18.7367	3.997
7	44.60	17.9281	3.961
8	46.40	17.1598	3.925
9	48.20	16.4295	3.888
10	50.00	15.7351	3.850
11	51.80	15.0746	3.812
12	53.60	14.4462	3.773
13	55.40	13.8482	3.733
14	57.20	13.2787	3.693
15	59.00	12.7365	3.652
16	60.80	12.2199	3.611
17	62.60	11.7275	3.569
18	64.40	11.2582	3.527
19	66.20	10.8107	3.485
20	68.00	10.3839	3.442
21	69.80	9.9767	3.399
22	71.60	9.5880	3.355
23	73.40	9.2169	3.311
24	75.20	8.8626	3.267
25	77.00	8.5241	3.223
26	78.80	8.2007	3.178
27	80.60	7.8915	3.134
28	82.40	7.5960	3.089
29	84.20	7.3134	3.044
30	86.00	7.0431	2.999
31	87.80	6.7844	2.954
32	89.60	6.5368	2.909
33	91.40	6.2998	2.864
34	93.20	6.0729	2.819
35	95.00	5.8555	2.774
36	96.80	5.6473	2.729
37	98.60	5.4477	2.684
38	100.40	5.2564	2.640
39	102.20	5.0729	2.595
40	104.00	4.8970	2.551
41	105.80	4.7282	2.507
42	107.60	4.5663	2.464
43	109.40	4.4109	2.421
44	111.20	4.2617	2.378
45	113.00	4.1185	2.335
46	114.80	3.9809	2.293
47	116.60	3.8487	2.251
48	118.40	3.7217	2.210
49	120.20	3.5996	2.169
50	122.00	3.4823	2.128
51	123.80	3.3695	2.088
52	125.60	3.2610	2.048
53	127.40	3.1566	2.009
54	129.20	3.0562	1.970
55	131.00	2.9595	1.932
56	132.80	2.8665	1.894
57	134.60	2.7769	1.857
58	136.40	2.6906	1.820
59	138.20	2.6076	1.784
60	140.00	2.5275	1.749
61	141.80	2.4504	1.713
62	143.60	2.3760	1.679
63	145.40	2.3044	1.645
64	147.20	2.2353	1.612
65	149.00	2.1687	1.579
66	150.80	2.1044	1.546
67	152.60	2.0424	1.515
68	154.40	1.9826	1.483
69	156.20	1.9248	1.453
70	158.00	1.8691	1.423
71	159.80	1.8153	1.393
72	161.60	1.7633	1.364
73	163.40	1.7131	1.336
74	165.20	1.6646	1.308
75	167.00	1.6178	1.280
76	168.80	1.5725	1.253
77	170.60	1.5288	1.227
78	172.40	1.4865	1.201
79	174.20	1.4456	1.176
80	176.00	1.4060	1.151
81	177.80	1.3678	1.127
82	179.60	1.3308	1.103
83	181.40	1.2949	1.080
84	183.20	1.2603	1.057
85	185.00	1.2268	1.035
86	186.80	1.1943	1.013
87	188.60	1.1629	0.992
88	190.40	1.1324	0.971
89	192.20	1.1029	0.950
90	194.00	1.0744	0.930
91	195.80	1.0467	0.911
92	197.60	1.0199	0.892
93	199.40	0.9939	0.873
94	201.20	0.9687	0.854
95	203.00	0.9443	0.837
96	204.80	0.9207	0.819
97	206.60	0.8977	0.802
98	208.40	0.8754	0.785
99	210.20	0.8538	0.769
100	212.00	0.8329	0.753